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ABSTRACT

The document is one of seven volumes of instructional materials developed around a cluster of Transportation Industries. Primarily technical in focus, they are designed to be used in a cluster-concept program and to integrate with a regular General Education Development (G.E.D.) program so that students may attain an employable skill level and a general academic background simultaneously. They provide basic skills necessary to enter a number of occupations in the Transportation cluster rather than an indepth development of skill in any one occupation. The volume contains approximately 120 hours of instruction in Transportation Systems and consists of 20 instructional units, each having one or more specific lessons. Each unit is designed for six hours, or one day, of instruction: three hours of technical laboratory instruction and three hours of related study in science, math, communications, and social studies. In most cases, there is only one lesson per unit. The units offer the instructor the essential materials: the aims (both in technical areas and in the four general education areas), instructional aids, topical outline and activities, suggested time sequence, evaluation guidelines, summary, and references. A selected bibliography concludes the volume. (Author/AJ)

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Commonwealth of Pennsylvania

Department of Justice

Bureau of Correction

VOCATIONAL EDUCATION
PROGRAM OF STUDIES

Elementary, Secondary Education Act

Title I

TRANSPORTATION CLUSTER

VOLUME VII

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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January 1, 1971
Pennsylvania Bureau of Correction

Harry A. Snyder
Director of Education

INTRODUCTION

The following information comprises one of seven volumes of instructional materials developed around a cluster of Transportation Industries and Occupations. These instructional materials are primarily technical in focus but are written to be used in a cluster concept program as part of an integrated curriculum.

The materials are aimed at preparing students with basic skills necessary to enter a number of occupations in industries within the Transportation cluster rather than providing an in-depth development of skill in any one occupation.

Each volume contains approximately one hundred twenty hours of instruction (about one month of study) and consists of twenty instructional units each having one or more specific lessons. Each unit is designed for six hours of instruction (three hours of technical laboratory experiences and three hours of related study in science, math, communications and social studies) but may be varied at the instructor's discretion.

The seven volumes or cluster areas in the series are:

Volume I - Automotive Services I
II - Automotive Services II
III - Small Power Sources
IV - Driver Training
V - Pneumatics, Hydraulics and Fluidics
VI - Farm and Earthmoving Equipment
VII - Transportation Systems

Students in the Transportation cluster should be introduced to the technical and integrated content through several methods closely related to the industrial structure. Among these are line production and assembly, group projects, experimentation, unit studies and independent study. Team teaching techniques should be employed between the academic specialist and the technical specialist and coordinators.

It is recommended that an orientation program be offered students to familiarize them with the cluster areas available so they may select one they wish to pursue. The cluster instruction is designed to integrate with the regular G. E. D. program so that students may receive an employable level of skill and a general academic background simultaneously.

As students select the technical cluster areas they wish to study, they should have the option to move through the G. E. D. content at their own speed using programmed instructional materials, instructional television, computer assisted instruction and other individualized learning techniques. Technical and integrated concepts are introduced each day by the specialists involved.

After completion of one or more months of study within another cluster providing, of course, this transfer is agreeable with the counselors, coordinators and instructors involved.

Lessons have been identified in the units. In most cases, however, there is only one lesson since each unit is limited to one day or six hours of instruction. The units offer the instructor the essential materials, vis-a-vis the aims, instructional aids, topical outline and activities, suggested time sequence, evaluation guidelines, summary and references. The primary and supplemental references are directly related to the topics and are important to the instructors. A selected bibliography is attached at the end of each volume as recommended additional sources of information.

Pagination of the units in this volume has been identified by cluster (T), volume (I, II, etc.), unit (1, 2, etc.) and page (.1, .2, .3, etc.) within each unit.

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INSTRUCTOR'S UNIT PLAN

Unit 1
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **An Overview of U. S. Transportation Systems**

AIM: To develop an understanding of the nature and scope of the carriers, classifications, in-plant traffic, routes, components and general transportation systems in the United States.

INSTRUCTIONAL AIDS:

Transparencies - Teacher-made transparencies showing statistics, classification schemes and types of carriers or modes.

Handouts - Maps showing transportation for the five basic modes.

Filmstrip - **Transportation: Where Do We Go From Here?** (M-420300), Pleasantville, New York: Guidance Associates, Harcourt, Brace and World, 1968 (118 frames, 19 minutes, color with record, $18.00).

Film - **The Romance of Transportation.** (IC298), Chicago: International Film Bureau (16 mm, 11 minutes, B&W or color, sound, $6.00 rental).

EQUIPMENT:

Overhead projector, screen, chalkboard and flipchart.

PRIMARY REFERENCES:

1) Moser, D. E. and Kriebel, W. R., **Transportation in Agriculture and Business**, Manual 63, Columbia, Missouri: University of Missouri Extension Division, 1964.

2) Taff, C. A., **Management of Traffic and Physical Distribution.** Homewood, Illinois: Richard D. Irwin, Inc., 1964.

I. INTRODUCTION and MOTIVATION

A. Present the fact that transportation is the largest form of economic activity. It represents over $100 billion per year or over 20% of the nation's gross national product. In 1960, over nine million or 14% of the total civilian labor force were directly connected with transportation industries.

B. Show pie graph transparency on distribution of the freight dollar.

II. PRESENTATION of INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Transportation as the leading economic activity.	1. Over $100 billion or 20 percent of Gross National Product. 2. Financial scope of transportation in terms of investments and returns.	
B. Statistics related to U. S. transportation systems (1963). 1. Measurement of service	1. Ways: a. 29,000 miles inland waterways b. 3,418,314 miles of streets and highways c. 135,000 miles of airways d. 200,000 miles of petroleum pipelines e. 220,000 miles railroads 2. Facilities: a. 103 large and 505 small railroad lines b. 81,630 airplanes (including jets) c. 50 scheduled airlines in domestic service d. 65,000 local, state, and interstate trucking companies with 12,730,000 trucks e. 1340 companies engaged in inter-city bus service using part of the 270,000 buses f. 70,000,000 passenger cars g. 1700 operators on inland waterways h. 21,021 towboats, tugs barges, and carfloats on the nation's rivers, canals, harbors, and Great Lakes i. 9,352 craft on Mississippi and Gulf intracoastal waterways 3. Ton miles. 4. Passenger miles.	
C. General types of carriers.	1. For hire: a. Common carriers b. Contract carriers 2. Indirect carriers. a. Freight forwarders b. Air and rail express c. Parcel post 3. Private carriers.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Understand economic concept of "investment" and "return."	1. Terminology related to modes, carriers, and their classifications.	1. Understand the concepts of time and place utility.
1. Computing averages (means). 2. Computing ton miles and passenger miles.	1. Prepare flow chart showing historical development of one of the basic modes. 2. Select a topic related to carrier classification and present a 15 minute talk on your research.	
		1. Comparsion of cost for "for hire" and "private" carriers for small firms, medium firms, and large firms. 2. Role of "common carriers" as a stabilizing force in transportation service.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
D. Carrier classifications and services. 1. Rail	1. Types of service. a. Carload (CL) b. Less carload (LCL) c. Unit train	
	2. Carrier classification by ICC. a. Class I (gross operating revenues of $3 million per year) b. Class II (less than $3 million)	
2. Motor	3. Classifications of commodities by ICC.	
	4. Accounting classifications. a. Class I (gross revenues exceeding $1 million annually) b. Class II (gross revenues from $200,000 to $1 million annually) c. Class III (gross revenues less than $200,000 annually)	
	5. Service classifications. a. Common carrier b. Contract carrier c. Private carrier d. Exempt carrier e. Local cartage f. Package service	
3. Water	6. General classification. a. Domestic b. Foreign	
	7. Common and contract certification and permits. a. Self-propelled vessels b. Sailing vessels c. Non self-propelled vessels with use of separate towing vessels d. Towing vessels e. Private vessels	
	8. Statistical classification of carriers. a. Class A (gross revenue exceeds $500,000 annually) b. Class B (gross revenue from $100,000 to $500,000 annually c. Class C (gross revenue less than $100,000 annually)	
	9. Domestic carriers.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Gross revenues. 2. Operating revenues.		1. Need for classification systems and schemes. 2. Advantages of an intergrated and coordinated transportation system. 3. Discussion of private or nationally-owned transportation systems.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	a. Coastwise b. Intercoastal waters c. Inland waters	
	10. Foreign (under American flag). a. Common carriers b. Contract carriers c. Industrial carriers d. Types of services 1) Liner 2) Tramp	
	11. Charter vessels. a. Time charters b. Voyage charts	
4. Air	12. Two basic types of carriers. a. Domestic carriers 1) Trunk line 2) Local service 3) Certificated cargo . . . only 4) Supplemental 5) Air taxi operators and helicopters 6) Charters b. Domestic carrier services 1) Deferred air freight 2) Air express c. International air carriers	
5. Pipe lines	13. Types of pipelines. a. Crude-oil gathering b. Crude-oil trunk c. Product	
	14. Statistical classification. a. Large lines (gross revenues over $500,000 annually) b. Other (gross revenues less than $500,000 annually)	
	15. Minimum tender requirements.	
	16. Natural-gas pipelines.	
6. REA Express	17. Offers LCL and CL services.	
7. Combination service	18. Trailer on flatcar or "piggy back" (TOFC) and container in trailer on flatcar (COFC) Type of service includes Plans I, II, III, IV, and V	
	19. Trailership or "fishy back".	
	20. Trainship.	
	21. Motor . . . air service (trucks, buses, and airplanes).	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
8. Frieght forwarders	22. Surface freight forwarders. 23. Air freight forwarders.	
9. Parcel post	24. Surface parcel post.	
10. Brokers	25. Air parcel post.	
11. Company-owned or company leased equipment	26. Interplant or intraplant service. 27. Facilities. a. Conveyors b. Elevators c. Escalators d. LP gas operated fork lifts and interplant transportation vehicles e. Cableways, aerial tramways, and ropeways	
E. Transport routes.	1. Lines of flow of carriers.	
1. Atlantic seaboard routes	2. East coast from Maine to Florida.	
2. North and Middle Atlantic-Gulf Coast routes	3. New York to Gulf coast points.	
3. Trunk line territory routes	4. Boston, New York, Washington, and Great Lakes area; Mississippi and Gulf Coast area.	
4. Pocohontas routes	5. Adjacent to trunk line routes.	
5. Mississippi Valley routes	6. Generally parallel to the Mississippi River.	
6. Eastern Gulf routes	7. Mississippi River to Memphis and the intracoastal canal region.	
7. Pacific Northwestern routes.	8. North Central and Northwest areas.	
8. Central and Overland routes.	9. Central and Western regions.	
9. Southwestern routes.	10. Texas and Southern area to Pacific Coast.	
10. Gulf-Pacific Coast or southern transcontinental routes.	11. New Orleans, Gulf Coast and Pacific Coast region.	
11. Pacific Coast routes.	12. North and South on Pacific Coast.	
12. Panama Canal routes.	13. Connect East and West Coasts.	
F. Gateways.	1. Importance of geography to transportation routes.	
	2. Cities such as Peoria, St. Louis, Omaha and the Twin Cities.	
	3. Mountian passes, rivers, valleys.	
	4. Delaware Water Gap, Cumberland Gap, Mohawk Valley, Donner Pass, etc.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Students should visit and tour one of the basic mode facilities and prepare a reaction report of their experiences.

B. Review annual reports and statistical reports of the various modes.

IV. EVALUATION CRITERIA GUIDELINE

A. What are the basic modes of transport?

B. What are the basic classification schemes for the modes?

C. Why are pipelines somewhat different than other modes?

D. Why is the railroad so important to the U. S. economy?

V. SUMMARY

A. Review the five basic modes (rail, motor, air, water and pipelines) and their classification schemes. Point out the recent trends toward international transport and the establishment of a national transport policy.

VI. SUGGESTED TIME and SEQUENCE LISTING

25 minutes . . . Statistics and general significance of transportation to the U. S. economy.

100 minutes . . . Discussion of basic modes and their classification schemes.

160 minutes . . . Field trip to transportation facility.

75 minutes . . . Related concepts in science, math, communications and social studies.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) "A Million Miles of Pipeline", **Time Magazine**, November, 1964.

2) **Railroads of America**, Washington, D. C.: Association of American Railroads (booklet).

3) "Ships Through the Ages: A Saga of the Sea", Washington, D. C.: **National Geographic Magazine**, April 1963.

4) **Silent Carriers**, Pelham, New York: Humble Oil Company (booklet).

5) **The Automobile Story**, Detroit: General Motors Corporation (booklet).

6) **Transportation Progress**, Detroit: General Motors Corporation (booklet).

INSTRUCTOR'S UNIT PLAN

Unit 2
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Air Transportation**

AIM: To develop an overview of the scope and function of air transportation and its importance to society; and to develop a degree of skill in one or more of these functions.

INSTRUCTIONAL AIDS:

Film - **Jet Terminal** (#49009), Ridgefield, New Jersey: Association Films, Inc. (16 mm, sound, color, 17 minutes, $3.00 rental).

Film - **The Crowded Air** (#BS-568), Ridgefield, New Jersey: Association Films, Inc. (16 mm, sound, B&W, 26 minutes, $8.50 rental).

Film - **Air Transportation** (#231), Philadelphia: Curriculum Materials Corporation (16 mm, sound).

Film - **Airport Helpers** (1 IFB 378), Chicago: International Film Bureau, 1965 (16 mm, sound, color, 10 minutes, $5.00 rental).

Film - **Air Taxi U. S. A.**, Washington, D. C.: National Air Taxi Conference, 1964 (16 mm, sound, 15 minutes).

Film - **Flight** (FA-117), Oklahoma City, Oklahoma: Federal Aviation Administration, 1962 (16 mm, sound, 28½ minutes).

EQUIPMENT:

8 mm, 16 mm projectors and screen.

PRIMARY REFERENCES:

1) Frederick, J. H., **Commercial Air Transportation**, Homewood, Ill.: Richard D. Irwin, Inc., 1961.

2) **Fundamentals of Aviation and Space Technology**, Urbana, Ill.: Institute of Aviation, University of Illinois Press, 1962.

3) **World Book Encyclopedia**, Chicago: Field Enterprizes Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Show film: **Jet Terminal** and lead class in discussion of jet terminal operations, parking, turning, loading and unloading passengers, etc.

B. Students should then visit a city airport to observe operations.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. History of air transport.	1. Balloons and gliders. 2. Wright Brothers' experiments. 3. Early flights. 4. Milestones in air travel. 5. Air mail and air passenger service. 6. Growth of aviation. 7. Jet age. 8. Aerospace. 9. Military use.	1. Theory of flight a. Structure and operation of conventional airplanes b. Structure and operation of helicopters 2. Principles of jet engine operation 3. Study lift characteristics of various wing shapes using window fan. 4. Demonstrate action . . . reaction principle of jet engine.
B. Air services.	1. Air passenger. 2. Air mail. 3. Air freight. 4. Service types. a. Domestic scheduled airlines b. International and overseas airlines c. Alaskian carriers d. IntraHawaiian carriers e. All cargo airlines	
C. Components.	1. Aircraft. a. Prop and turbo-prop planes b. Jet planes c. Private (lightweight) planes d. Military e. Airship f. Helicopter g. Convertabie aircraft (VTOL, VSTOL, amphibian, etc.) h. Sea planes 2. Airports. a. Terminals b. Hangars c. Control tower d. Runways e. Storage f. Maintenance and repair g. Aircraft service and repair h. Meteorologist facilities i. Parking (short term and long term) j. Public transportation vehicle stations 3. Control systems. a. Lighting b. Beacon	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Aircraft nomenclature. 2. Case study of famous "Billy Mitchell."	1. The Kelly Act and its impact on air mail service. 2. Important dates to remember in air transport development.
	1. Identification of forms, records, and data on airline operations.	1. Emphasis on service to public by airlines. 2. Class of people who fly regularly.
1. Computing total cost of airline operations. a. Direct b. Indirect	1. Communication by code. a. Standard Morse code b. Radar 2. Radio communications.	1. Government support (financial) of airports and airline operations. 2. Effects of air transport on other modes. 3. Manufacture of aircraft. 4. Effects of airport location and traffic on communities. 5. Priorities and restrictions on military air bases.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	c. Landing aids 1) Radio, radar, and electronic instruments 4. Military air bases. a. Security b. Weapons arsenal c. Military quarters d. Restricted air and ground space 5. Power plants. a. Reciprocating propeller b. Turbo-prop c. Jet	
D. Major airlines.	1. Commercial. 2. Charter.	
E. Air navigation.	1. Maps and charts. 2. Forms of navigation. a. Pilotage b. Dead reckoning c. Radio	
	d. Celestial 3. Air space requirements. a. Air routes b. Safety rules for VFR and IFR c. Victor airways	
F. Meteorology.	1. Flying weather conditions. 2. Weather information available to pilots. 3. Weather recording and reporting.	1. Scientific weather recording procedures. a. Cloud formations b. Air pressure (high and lows) c. Temperature d. Moisture e. Air masses and fronts f. The atmosphere
G. Air traffic control and communication.	1. Air traffic control procedures. 2. Aircraft-control tower communications. 3. Flight plans. 4. Air traffic service. a. Air termnial problems 5. V.O.R.	1. Electronics in aviation a. Radio b. Radar c. Landing aid instruments

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Geographic location of aircraft manufactures.
1. Converting nautical miles to statute miles. 2. Distances in air space requirements. 3. Calculate flight times using wind velocity, aircraft speed and distance.	1. Reading navigational charts and graphs.	
		1. How weather affects man's travel habit.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
H. Government regulations.	1. Federal Aviation Agency. a. Personnel b. Function 2. Civil Air regulations. 3. Pilot regulations. 4. Civil Air Patrol.	
I. Passenger handling operations.	1. Reservations. a. Electronic 2. Scheduling. 3. Flight forecast and advisories. 4. Ticketing a. Refunds 5. Routing. 6. Special services. a. Limousine b. In flight enterainment c. Vehicular shuttle to and from plane	
J. Freight handling operations.	1. Packing. 2. Documentation. 3. Pickup and delivery. 4. Insurance. 5. Handling freight. a. Truck b. Trucktrain c. Conveyor d. Chute e. Etc. 6. Other. a. Air freight b. Shippers' associations c. Air-truck	
K. General aviation.	1. Commercial flying. 2. Bussiness flying. 3. Instructional flying. 4. Pleasure flying. 5. Job opportunities in air transportation.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Why government regulation of air transport is necessary.
1. Cost of service to passenger for airline transport compared to rail, motor, and sea transport.	1. Handling people and their problems. 2. Securing services for passengers. 3. Easing passengers fear of flight. 4. Electronic reservation communications.	1. Prestige of air transportation.
1. Salaries of personnel in air transport industries. 2. Economic advantage of business firm owning own plane.		1. General training and/or education needed for personnel in air transportation. a. Executives b. Pilots c. Stewardesses d. Engine maintenance e. Etc. 2. Rapid growth of pleasure and private flying.

III. APPLICATION

A. Students should spend one or two full days at an airport to observe and gain experience with some of the airline operations. This exposure may start with a small airfield or county airport where students can see the interrelationships of the total operation and can become a part of these operations.

IV. EVALUATION CRITERIA GUIDELINE

A. Identify types of air transport services available.

B. What does the future hold for air transportation?

C. How has air transportation changed over the last decade? The last three decades? the last 60 years?

D. What employment opportunities exist in air transport?

V. SUMMARY

A. Air transportation is one of the fastest growing forms of transport. Airports and giant jet planes are creating societal reactions in terms of noise, pollution and traffic.

B. Review emphasis on regulation and control of air transport for safe operation.

VI. SUGGESTED TIME and SEQUENCE LISTING

30 minutes . . . Show film and start discussion.

330 minutes . . . Experiences and skill development activities at air terminal.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Blacker, R. D., **Basic Aeronautical Science and Principles of Flight.** Chicago: American Technical Society, 1958.

2) Port of New York Authority, **Transportation by Helicopter: A Study of Its Potential in the New Jersey-New York Metropolitan Area,** New York: Aviation Department, 1952.

3) Tobin, A. J., "The Airport's Influence on Air Transport," **World Airports,** August 1962, p. 553.

4) U. S. Civil Aeronautics Board, **Handbook of Airline Statistics,** Washington, D. C.: The Aeronautics Board, no date.

5) U. S. Federal Aviation Agency, **National Airport Plan,** Washington, D. C.: The Agency, 1962.

INSTRUCTOR'S UNIT PLAN

Unit 3
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Rail Transportation**

AIM: To develop an overview of the scope and functions of rail transportation and to develop a degree of skill in some of these functions.

INSTRUCTIONAL AIDS:

Film - **Mainline U. S. A.**, Chicago: Illinois Central Railroad, 1957 (16 mm, sound, 20 minutes).

Film - **Milepost 100**, Chicago: Santa Fe Film Bureau, 1968 (16 mm, sound, 28 minutes).

Film - **New Directions in Modern Railroading**, Chicago: Farm Film Foundation, Illinois Central Railroad, 1967 (16 mm, sound, 27 minutes).

Film - **Science Rides the High Iron**, Chicago: Farm Film Foundation, Illinois Central Railroad, 1961 (16 mm, sound, 25 minutes).

Film - **Turbo**, Buffalo, New York: Canadian National Railways (16 mm, sound, 10 minutes).

Charts - Showing colored illustrations of the types on signals used in railroading.

EQUIPMENT:

16 mm projector and screen.

PRIMARY REFERENCES:

1) **Diesel: The Modern Power**, Detroit: General Motors Corporation (booklet).

2) General booklets available from Association of American Railroads, Washington, D. C.:

a. **A Review of Railway Operations.**
b. **Bibliography of Railroad Literature**, 1961.
c. **Railway Statistics Manual.**

3) **World Book Encyclopedia**, Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Invite a speaker in from local railroad company to present opportunities available in railroading. Discuss new management and electronic operations in railroading and their effects on public image of railroads.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Brief history of railroading.	1. Inventors and inventions. 2. Red-letter dates in railroading. 3. History of federal legislation and controls. 4. Significance of railroads today.	1. Principles of steam engines.
B. Rail transport services.	1. Types of service. a. Passenger b. Freight c. Express d. Mail	
C. Components.	1. Right-of-way. a. Planning and acquisition b. Surveying 2. Tracks or "way" a. Gauge b. Roadway c. Grades and curves d. Tracks e. Bridges f. Tunnels	1. Principles of diesel engines.
	3. Rolling stock. a. Freight cars b. Passenger cars c. Coaches d. Special cars e. Engines 4. Rail stations and terminals. a. Rural and urban stations b. Terminals c. Rail yards 5. Engine houses and shops. a. Storage b. Overhaul and rebuilding 6. Power plant a. Diesel b. Diesel-electric c. Steam	
D. Signals and safety devices.	1. Automatic block signals. 2. Fixed signals. 3. Hand, flag, and lamp signals. 4. Whistle signals. 5. Train signals.	1. Principles of air brakes and mechanical brakes.
E. Train assembly.	1. Preparation. a. Humping b. Coupling	1. Coupling mechanism.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Financial monopoly.	1. Economic terms related to railroad industry. 2. Understanding graphs and charts showing statistics, routes, financial analysis, etc.	1. Development and impact of steam engine. 2. Competition with waterways and canals. 3. Government interest and control of railroads.
	1. Passenger information service. 2. Mail distribution and sorting.	1. Significance of railroad transport in opening up the Western part of U. S. 2. Industrial giants and monopoly.
1. Cost of right-of-ways. a. Land acquisition b. Overland vs. tunneling cost		1. Concept of "eminent domain."
1. Test of distances and vision.	1. Signal design for communication. a. Color b. Size c. Shape	1. Safety in railroading.
	1. Contracting rail service.	1. Development of "common carrier."

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	c. Marking d. Arrangement of cars e. Position of locomotive	
F. Other types of trains.	1. Electric commuter. 2. Elevated trains. 3. High speed passenger. 4. "Unit" trains. 5. TOFC (Piggyback).	1. Principle of electric motor. 2. Transmitting electricity over long distances.
G. Major U. S. railroad companies.	1. Current mergers and census count. 2. Operational statistics. 3. Geographical regions serviced.	
H. Regulation of railroads.	1. ICC rules. 2. DOT rules. 3. Rates. 4. Economics of rail transport.	
I. Careers in railroading.	1. Lists of jobs and opportunities. 2. Salary ranges and benefits. 3. Unions and working conditions. 4. Job descriptions.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		2. Reasons leading to decline of "common carrier."
	1. Effects of luxuary services on railroads' public image and economic growth.	1. Innovations in railroading to stimulate the industry's economy. a. Piggyback b. Sea train c. Unit train d. Automotive carrier
1. Statistical accumulation and analysis.		
1. Computing rates. 2. Fixed cost. 3. Variable costs.	1. Understanding ICC and DOT rules and regulations for carriers.	

III. APPLICATION

A. Students should work in an actual or simulated railroad terminal, yard, roadway construction and maintenance shop to gain a broad perspective on total railroad functions. Students should select one or more of these specific functions and begin to develop a degree of skill in it.

IV. EVALUATION CRITERIA GUIDELINE

A. What four types of service do railroads provide for the public?

B. Identify and explain uses of freight and passenger cars.

C. What are the chief groups of railroad signals?

D. What are the four leading kinds of freight carried by U. S. railroads?

V. SUMMARY

Railroads were the backbone of U. S. transportation and were significant in the early westward expansion and development. Motor carriers, however, are now prominent in interstate and intrastate transport. The common carrier is basic to our national transportation system and must be preserved.

VI. SUGGESTED TIME and SEQUENCE LISTING

40 minutes . . . Speaker on railroading followed by discussion.

20 minutes . . . Related concepts in science, math, communications and social studies.

300 minutes . . . Experiences in railroad operations at a railroad facility.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Moskowitz, S., **Great Railroad Stories of the World.** New York: McBride Company, 1954.

2) Murray, D. M., **Man Against Earth: The Story of Tunnels and Tunnel Builders.** Philadelphia: J. B. Lippincott Company, 1961.

3) **Railroad Quiz.** Washington, D. C.: Association of American Railroads, 1970.

4) **Railroad Review and Outlook.** Washington, D. C.: Association of American Railroads, 1970.

5) **Railroads of America.** Washington, D. C.: Association of American Railroads, 1970.

6) Stillman, W. D., "The Commuter Crisis," Remarks on transportation in New Jersey before the Sales Executive Club of Nothern New Jersey, April 25, 1966.

7) Stover, J. F., **American Railroads.** Chicago: University of Chicago Press, 1961.

8) Taylor, G. R., **Transportation Revolution 1815-1860, The.** New York: Holt, Rinehart & Winston, Inc., 1961.

INSTRUCTOR'S UNIT PLAN

Unit 4
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Highway Transportation**

AIM: To develop an understanding of the scope and function of motor transport and to gain basic skills in the operations involved.

INSTRUCTIONAL AIDS:

Filmstrip - **Driving Your 53/71 Diesel Truck (25SE21).** Detroit: Detroit Diesel Engine Division of General Motors Corporation (35 mm, sound, color).

Film - **From Byway to Superhighway.** College Park, Md.: The Asphalt Institute, 1957 (16 mm, sound, 16½ minutes).

Film - **Lifeline on Wheels.** Washington, D. C.: American Trucking Association, Inc., 1965 (16 mm, sound, 28 minutes).

Fil m- **Design for Highway Safety (#496).** Ne wYork: National Association of Manufacturers (16 mm, sound).

EQUIPMENT:

16 mm, 35 mm projectors, screen, model trucks, autos, bicycles and motorcycles; a diarama depicting urban, suburban and rural highways.

PRIMARY REFERENCES:

1) Colt, S., "240,000 Riders Use Bus Terminals Daily," **Westsider,** Summer 1964.

2) Curtiss, R. S., "The Port Authority Bus Terminal," **Skyscraper Management,** January, 1952.

3) Kiley, E. U., **Highway Transport Potential.** Washington, D. C.: American Trucking Association, 1959.

4) Sidney Hollander Associates, **The COD Customer's View of Interstate Household Moving.** Baltimore: Sidney Hollander Associates, 1969.

5) Tobin, A. J., "Modern Truck Transportation at the Port of New York," Address before Annual Spring Meeting of Operations Council, ATA, May 7, 1957.

6) **Truck Owner's Manuals.** Detroit: Helm, Inc.

7) **World Book Encyclopedia.** Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Introduce and show film: **Lifeline on Wheels.** Discuss how trucking industry has affected growth of suburban and rural areas, also how it affects our standard of living.

B. Compare the bus, truck, motorcycle and automobile as means of transportation in terms of cost, geographic location, service, public image and needs.

II. PRESENTATION of INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Review statistics of motor transport.	1. Registration, cost, sales, miles traveled, services rendered, etc.: a. Automobile b. Bus c. Truck d. Motorcycles e. Taxicab	
B. Brief history of motor transport.	1. Periods of growth: a. Coaches b. Engine development c. First highways d. Federal regulation e. Red letter days in the development of motor transport f. Present status g. Likely trends	
C. Motor services.	1. Types of service: a. Passenger b. Freight c. Mail d. Moving household goods e. Express	
D. Components.	1. Vehicles. a. Private automoblie b. Taxi c. Limousine d. Truck e. Bus f. Motorcycle and bicycle 2. Classifications of vehicles. a. For licensing and registration b. By ICC rules 3. Highways. a. 1st, 2nd, 3rd class roads b. Superhighways c. Special roads d. Interchange design e. Highway controls f. National defense highway system 4. Stations and terminals. a. Bus terminals b. Truck terminals c. Automobile storage and parking facilities d. Street parking and traffic flow 5. Traffic control and regulation.	1. Principles of gasoline engine a. Oxidation of fuels b. Ignition system c. Cooling systems d. Lubrication 2. Transmission of power. 3. Principles of diesel engine. 4. Principles of turbine.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Statistical gathering and analysis.	1. Statistical reporting: use of symbols, formulas, and procedures.	1. Significance of transportation statistics in the gross national produce figure. a. Implications of these figures
	1. Read Reck's ROMANCE OF AMERICAN TRANSPORTATION.	1. Significance of the wheel to transportation. 2. Wheeless vehicles. 3. Economic growth of motor transport.
1. Computing fares and other service costs.	1. Reading and understanding a highway map.	
1. Cost analysis of vehicular operation per mile; per passenger mile; per ton mile. 2. Comparative cost of urban public transport and private vehicle use.	1. Reading operation and service manuals of vehicles. 2. Understand highway control devices and their meaning. 3. Preparing highway traffic reports. 4. Broadcasting from helicopter, police car, or base. 5. Highway research gathering techniques.	1. Impact of superhighways on land value and use. 2. National plan for defense highway system. 3. Need for local, state, and federal regulation of motor vehicles other than private autos. 4. Problems with terminals located in urban centers. 5. Declining use of motor vehicles for intercity passenger transport. 6. Law enforcement in traffic control.

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	a. Traffic assignment and distribution b. Highway patrol and state police c. Highway traffic reporting d. Traffic control devices e. Cordon stations 6. Power plants a. Gasoline b. Diesel c. Turbine	
E. Major motor transport companies.	1. Manufactures of vehicles. 2. Companies providing transport service. a. Taxi and limousine b. Bus c. Truck	
F. Motor transport vehicle service facilities.	1. Vehicle service centers. a. Service stations b. Dealership garages c. Specialist shops d. Terminal maintenance facilities	
G. Operational procedures.	1. Documentation. a. Including accounting and insurance b. Claims 2. Tickets and reservations. 3. Dispatching and routing. 4. Union regulations. 5. Insurance regulations. 6. ICC regulations.	
H. Highway safety.	1. Accident prevention programs. 2. Accident reporting and accounting.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Basic concept of stocks, bonds, shares, and investment.	1. Compiling of major trucking and bus companies.	
1. Maintenance costs.	1. Use of appropriate vehicular terminology to clarify descriptions of maintenance needs.	
1. Cost of union membership and employee fringe benefits.	1. Transcribing recorded information.	1. Union structure and operation. 2. Racism in unions.
		1. Study of alcoholism and accident prevention on highways.

III. APPLICATION

A. Students should experience the typical operations of bus, truck, taxi and limousine and automobile transportation services including terminal functions, vehicular operation, origination and destination assignments, documentation and other procedures involved in motor transport.

IV. EVALUATION CRITERIA GUIDELINE

A. How would the motor transport modes be ranked in terms of total passenger miles? Total ton miles?

B. What are the major differences in operations of trucks and busses as a transportation facility?

C. Identify some trends in motor transport.

V. SUMMARY

A. Review the types and nature of vehicles and ways used in motor transport and how they compare with each other.

B. Technological changes in vehicular design has been necessary to stimulate growth in passenger travel.

C. Emphasis on accident prevention and highway safety.

VI. SUGGESTED TIME and SEQUENCE LISTING

45 minutes . . . Showing film and discussion of film.

255 minutes . . . Experiences in at least one transport terminal or vehicle to learn how that particular phase of motor transport operates.

60 minutes . . . Related study in math, communications and social studies.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) ATA,**Highways - - - The Years Beyond 1972,** Current Report Number 5, Washington, D. C.: The Association, February 1965.

2) **Bus Facts,** Washington, D. C.: National Association of Motor Bus Owners, 1968.

3) Department of Research and Transport Economics, **American Trucking Trends 1968,** Washington, D. C.: American Trucking Association, Inc., 1968.

4) Donovan, F. R., **Wheels for a Nation,** New York: Thomas Y. Crowell Company, 1965.

5) Helly, W., **Efficiency in Road Traffic Flow,** New York: Port of New York Authority, 1963.

6) Herring, F. W., "The Future Tasks of Metropolitan Transport." Presented at the World Traffic Engineering Conference, August 24, 1961.

7) Lee, L. and Lambert, D., **Wonderful World of Transportation, The,** New York: Doubleday and Company, Inc., 1960.

8) Port of New York Authority, **Control of Traffic in Tunnels to Maximize Flow,** New York: The Authority, 1965.

9) **Preventive Maintenance: Is It Worth The Effort?,** Muskegon, Michigan: Continental Motors Corporation, 1957.

10) "Without a Driver," **Transportation and Distribution Management,** January 1970, p. 25.

INSTRUCTOR'S UNIT PLAN

Unit 5
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Marine Transportation**

AIM: To develop an understanding of the scope and function of marine transportation and to gain basic skills in one or more of these functions.

INSTRUCTIONAL AIDS:

Kits - Foreign trade information kits on topics related to marine transportation. See **Transportation and Distribution Management Magazine,** March 1969, pp. 44-46.
Film - **Bridging the Seas,** New York: Associated Films, Inc., 1966 (16 mm, sound, 72½ minutes).
Film - **Duluth-Superior, Where the Seaway Begins,** Duluth, Minn.: Seaway Port Authority of Duluth, 1966 (16 mm, sound, 28 minutes).
Film - **Forever Free,** New York: Associated Films, Inc., 1962 (16 mm, sound, 28 minutes).
Film - **Of Ships and Cargo,** Portland, Oregon: Portland Public Docks, 1960 (16 mm, sound, 18 minutes).
Film - **People Afloat,** Available through the local Red Cross Chapter, 1962 16 mm, sound, 14½ minutes).
Charts - Showing the U. S. Inland, Great Lakes and Coastal Waterways. Available through local Corps of Engineers Office.

EQUIPMENT:

16 mm projector, screen, model boats, model of canal and lock and model navigational aids.

PRIMARY REFERENCES:

1) American Waterways Operators, Inc., **Big Load Afloat,** Washington, D. C.: American Waterways, 1965.

2) Chapman, C. F., "Piloting, Seamanship and Small Boat Handling," New York: **Motor Boating,** 1970 edition.

3) Lawrence, S. A., **United States Merchant Shipping Policies and Politics,** Washington, D. C.: Brookings Institution, 1966.

4) **Ships,** Chester, Pennsylvania: Sun Shipbuilding and Dry Dock Company (no date given).

5) **World Book Encyclopedia,** Chicago: Field Enterprises Educational Corporation, 1970 .

I. INTRODUCTION and MOTIVATION

A. Introduce and show film: **Forever Free.** Discuss the role of shipping industry in U. S. and other countries. Show statistics of merchant marine with transparencies and develop general scope of water transport.
B. Take class to nearby seaport to observe and participate in operations which will give them basic skills.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. An overview of water transport.	1. Statistics of water transport. 2. Increase in water transport during last decade. 3. Types of vessels in use today. 4. General financial profile of commercial shipping.	
B. Brief history of wated transport.	1. Ancient boats and routes. 2. Sailing ships. 3. War ships. 4. Steamships. 5. Technological developments in ships. 6. Modern ships. 7. Red letter dates in the development of water transport.	
C. Water transport service.	1. Types of service. a. Passenger. b. Freight. c. Assistance (towing, tugboat)	
D. Components.	1. Types of vessels. a. Passenger ships or ocean liners b. Freighters c. Tankers d. Bulk carriers e. Refrigerator ships f. Ore boats g. Tugboats, tow boats h. Barages and scows i. Military j. Recrational k. Commercial fishing boats 2. Ways. a. Channels and canals b. Rivers c. Seaways d. Ocean e. Lakes 3. Major inland water routes. a. New York State Barge Canal b. Major rivers c. Great Lakes d. Mississippi River system e. Gulf intracoastal f. Atlantic intracoastal	1. Types of marine engines a. Use of cheaper fuels b. Use of sea water for cooling 2. Displacement of water. 3. Factors affecting ship design.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Statistical gathering techniques.	1. Interpreting charts, graphs, figures, and tables.	1. Significance of water transportation to U. S. coastal areas; inland areas; international relations.
	1. Read novel on history of shipping: a. BILLY BUDD b. MOBY DICK c. ESCAPE TO DANGER d. CON TIKI e. TITANIC	1. Importance of historically famous vessels in commerce and in war. 2. Impact of piracy on shipping.
		1. Who carries what commodities? 2. Water transport and national defense.
1. Scaling models of actual ships. 2. Figuring horsepower rating of marine engines. 3. Mathematics employed in navigation.	1. Identification of different vessels. 2. Navigation system. a. Structure b. Use 3. Ship and boat construction terminology. 4. Nautical vocabulary.	1. Impact on inland waterways on land use and development. 2. Pollution problems with inland water routes. 3. Application of nuclear power to shipping.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	4. Major international routes. a. Atlantic Ocean b. Pacific Ocean c. Panama Canal 5. Locks and dams. a. Design and operation 6. Ports and terminals a. Coastal ports b. Great Lakes ports c. River and canal ports d. Types of terminals 7. Power plants. a. Steam turbine b. Diesel c. Nuclear d. Gasoline 8. Navigational systems.	
E. Ship and boat construction.	1. Nomenclature of vessels. 2. Hull materials. a. Wood b. Metal c. Plastic d. Concrete 3. Nautical terms and their use.	1. Materials development and composition. a. Fiber glass b. Plastic 2. Marine paints. 3. Effects of marine life and water on boat hulls.
F. Shipping industries.	1. Leading shipping companies in the U. S.	
G. Water recreation.	1. Pleasure boats and crafts. 2. Recreation facilities. 3. Safe boating.	
H. Advisory and controlling bodies.	1. Interstate Commerce Commission. 2. U. S. Coast Guard. 3. U. S. Army Corps of Engineers.	
I. Occupation in water transport.	1. On board ship. 2. Port and terminal. 3. Shipyards and boat sheds. 4. Management. 5. Customs.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Determining size and shape of hull and superstructure.		1. Declining wood-boat industry. 2. Use of "surface effects" vehicles.
	1. Composition of "ship's papers." 2. Documentation in shipping.	1. Rank position of U. S. in merchant fleet operation and documentation. 2. Taxation and tariffs.
	1. Recognizing signals from other boats.	1. Growing problem of pleasure boating enthusiasts and crowded lakes, rivers, and waterways.
		1. Role of Coast Guard and subsidiaries in controlling small boat operations.

III. APPLICATION

A. Students should spend at least one day at the pier, terminal, on ship or other waterfront activity to begin to experience simple operations in the shipping industries.

IV. EVALUATION CRITERIA GUIDELINE

A. Identify specific types of vessels (commercial).
B. What are the largest occupational groups in shipping?
C. What are some of the problems developing in recreational boating?
D. Describe some of the historically famous ships and why they are famous.

V. SUMMARY

A. Ships are the largest bulk carrier per vehicle of the modes. They are not so heavily regulated as other modes.
B. Ships lend themselves to applications of nuclear power more naturally than the other modes and will create an impact in the competitive market if this form of power is refined.

VI. SUGGESTED TIME and SEQUENCE LISTING

30 minutes . . . Show film.
300 minutes . . . Visit water transport facility to observe and experience operations.
30 minutes . . . Summary and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Board of Engineers for Rivers and Harbors, **Inland Water-Borne Commerce Statistics**, Washington, D. C.: Corps of Engineers (no date).

2) Board of Engineers for Rivers and Harbors, **Water Site Plant Locations and Expansions**, Washington, D. C.: Corps of Engineers (no date).

3) Klette, E. J., **From Atlantic to Pacific: A New Interocean Canal**, New York: Harper & Row Publishers, Inc., 1967.

4) May 1970 issue of **Transportation and Distribution Management Magazine.**

5) Morris, J., **The Great Port**, New York: Harcourt, Brace and World, Inc., 1969.

6) Office of Maritime Promotion, **Merchant Fleets of the World**, Washington, D. C.: Superintendent of Documents, December 1965.

7) Peters, G. J., "Physical Distribution: The European Difference," **Transportation and Distribution Management**, March 1969, pp. 27-33.

8) Port of New York Authority, **A Plan for a New Consolidated Passenger Ship Terminal in the Port of New York**, New York: The Port Authority, April 1967.

9) Royce, P. M., **Boating Illustrated**, Columbia, Missouri: ABOS Publishing Company, 1962.

10) **The Merchant Marine Act, 1936**, Washington, D. C.: Government Printing Office, 1961.

11) "The Role of the Foreign Freight Forwarder and Customhouse Broker in Distribution," **Transportation and Distribution Management**, March 1969, pp. 34-41.

12) Villiers, A., "Ships Through the Ages: A Saga of the Sea," **National Geographic Magazine**, Volume 123, April 1963, pp. 494-544.

1) "Who Carries What Commodities." **Dun's Review**, A Special Report to Management, June 1963, pp. 20-21.

INSTRUCTOR'S UNIT PLAN

Unit 6
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Pipeline Transportation**

AIM: To develop an understanding of the scope and function of transportation by pipelines and to gain basic skills in one or more of these functions.

INSTRUCTIONAL AIDS:

Film - **Hidden Harvest.** New York: American Gas Association, 1962 (16 mm, sound, color, 18 minutes).
Film - **On Stream.** Ridgefield, N. J.: Gulf Eastern Film Library, 1964 (16 mm, sound, color, 17 minutes).
Film - **Our Roots Are Deep.** New York: American Gas Association, 1961 (16 mm, sound, color, 60 minutes).
Film - **Pipeline of Progress.** New York: American Gas Association, 1956 (16 mm, sound, color, 23 minutes).
Map - Map Showing pipeline network in U. S.
Chart - Showing products of petroleum distillation.

EQUIPMENT:

16 mm projector and screen.

PRIMARY REFERENCES:

1) Career information on jobs in the petroleum industry, available from American Petroleum Institute, Avenue of the Americas, New York, N. Y. 10020.

2) Haskell, R. H., "The Hidden Industry," **Transportation and Distribution Management,** October 1969, pp. 48-51.

3) **Silent Carriers - - - A Transportation Story,** Bala-Cynwyd, Pennsylvania: Esso Standard, Humble Oil & Refining Company, 1961.

4) **World Book Encyclopedia.** Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Introduce and show film: **On Stream** or **Our Roots Are Deep.** Discuss the film and the importance of pipelines.

B. Point out that pipelines are the third largest cargo carrier by volume and the fastest growing of the basic modes.

II. PRESENTATION of INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Review basic statistics of pipelnie transport.	1. Pipeline mileage and diameter. 2. Percent of ton miles carried by pipelines. 3. Vonstruction cost. a. Size and number of companies 4. Products carried. a. Natural gas b. Crude oil c. Petroleum products d. Other products	1. Molecular structure of crude oil. 2. Volatility of petroleum and natural gas products. 3. Viscosity levels. 4. Factors affecting pipeline flow: a. Pipe diameters b. Pumping pressure c. Pipe friction d. Liquid viscosity 5. Valves
B. Brief history of pipelines.	1. Pipelines in ancient societies. 2. Roman pipelines. 3. First pipelines in U. S. 4. Discovery of oil. 5. Development of highway and railway vehicles to carry petroleum products. 6. Regulation of pipelines. 7. Modern pipelines.	
C. Pipeline services.	1. Basic freight services: a. Common carrier or product lines b. Trunk lines c. Gathering lines	
D. Components.	1. Right of way. a. Planning and acquisition 2. Carrier. a. Type of line b. Size and shape of line 3. Storage facilities. a. Tank farms b. Pumping stations 4. Oil wells and natural gas supplies. a. On shore b. Off shore 5. Refineries. 6. Pipeline construction and laying.	1. Insulative materials used on pipelines. 2. Pressure and other forces acting on a pipeline. 3. Chemical treatment of products. a. Solvent refining process 4. Principles of "cracking," "polymerization," "alkylation," "hydrogenation," and "reforming."

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computing radius, diameter, and circumference.	1. Understanding charts and graphs. 2. Developing pipeline vocabulary.	
1. Economic impact of pipeline transport on gross national product.	1. Read stories of early pipeline uses by Romans.	1. Important dates to remember in pipeline development. 2. Reasons for regulating pipelines.
1. Percentages of service in product, trunk, and gathering lines.	1. Selecting and using appropriate pipeline service.	
1. Cost of right of ways. 2. Pumping station distances on the line.	1. Buying and selling right-of-way. 2. Securing land leases from owners. 3. Interviewing employees.	1. Locating a tank farm. 2. Geographic location of oil wells and gas wells. 3. Problems of off-shore wells. a. Pollution b. Personnel c. Accessibility 4. Locations of refineries. a. Criteria for location b. Community reactions 5. The Black Mesa pipeline.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
E. Traffic control.	1. Bulk shipments. 2. Minimun tender. 3. Scheduling and dispatching. 4. Oil pipeline measurement and measuring systems. a. Batch separators and buffers 5. Automated controls.	1. Product buffers. 2. Characteristics of crude oil and petroleum products. 3. Characteristics of natural gas. 4. Safety procedures for handling these products.
F. Major U. S. pipeline companies and systems.	1. Crude oil and petroleum products. 2. Natural and artificial gas. 3. Slurry lines. 4. Experiments with pipelining solids.	
G. Regulation of pipelines.	1. ICC regulation. 2. Federal Power Commission regulation of natural gas lines.	
H. Careers in pipeline industries.	1. Drilling. 2. Laying pipelines. 3. Operation and management of pipelines.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Measuring tank capacity for liquids.	1. Communications within the pipeline industries. 2. Scheduling and dispatching.	1. Oil field conservation. 2. Refinery conservation. 3. State conservation laws. 4. Effects of automation in pipeline industry.
1. Investment guidelines. 2. Industrial financing. 3. Regulation of costs.		1. Location of major oil companies around the world.
	1. Understanding regulatory documents.	1. Basic economic principles invovled in pipeline transport.
1. Salary ranges and educational preparation of employees.	1. Testing procedures used by personnel managers in pipeline industries.	1. Degrees of skilled, technical, and professional employees needed.

III. APPLICATION

A. Students should be able to spend at least one day touring a tank farm and well operation to see how the gathering, storage, scheduling and dispatching is handled. Students should have an opportunity to assist in some of these functions to gain experience in them. Another day or two should be spent at a refinery to observe and study its operation.

IV. EVALUATION CRITERIA GUIDELINE

A. What are the basic service lines called?

B. Why are pipelines the fastest growing mode?

C. What are some petroleum products produced at refineries?

D. What are some petroleum by-products?

E. What effects would an electric powered automobile have on the petroleum industry?

V. SUMMARY

A. Since pipelines are the third largest carrier and the fastest growing of the modes, greater attention needs to be given to the development of this form of transport. A great future seems to be ahead of pipeline transport, particularly in light of the experiments with pipelining solids.

VI. SUGGESTED TIME and SEQUENCE LISTING

60 minutes . . . Show one of the films suggested in introduction.

300 minutes . . . Field trip to oil or natural gas wells and storage facilities.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) "Atlas of Products Pipelines of the United States," **Oil and Gas Journal**, September 23, 1963, pp. 201-224.

2) **Common Carrier Pipeline Operations and Accounting**, Tulsa, Oklahoma: Ross-Martin Company, 1951.

3) Hartley, A. C., "Transportation by Pipeline," **Journal of the Institute of Transport**, January 1959, pp. 33-46.

4) Leeston, A. M., **The Dynamic Natural Gas Industry**, Norman, Oklahoma: University of Oklahoma Press, 1963.

5) "Paying the Piper," **Time**, November 20, 1964.

6) Petroleum Extension Service, **Oil Pipeline Transportation Practices**, Volume I, Austin, Texas: University of Texas, 1953.

7) "Petroleum Panorama," **Oil and Gas Journal**, January 28, 1959 (entire issue).

8) "Pipelines and Pipeline Transportation," **Transport and Communications Review**, October - December 1952, pp. 23-24.

9) Taff, C. A., **Management of Traffic and Physical Distribution**, Homewood, Illinois: Richard D. Irwin, Inc., 1964.

10) "The Transmission of Natural Gas," **Business Review**, Federal Reserve Bank of Dallas, May 1961, pp. 1-8.

11) Unruh, E. W., "Pipelines in Distribution," **Transportation Frontiers**, edited by Karl Ruppenthal, Stanford, California: Stanford University School of Business, 1962.

INSTRUCTOR'S UNIT PLAN

Unit 7
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Documentation in Transportation**

AIM: To develop an understanding of the documentation necessary for transporting goods and people and to develop skill in preparing these basic documents.

INSTRUCTIONAL AIDS:

Sample document forms (Bills of lading).

Transparencies - Sample Bill of Lading forms for each mode.

Film - **Transportation Go-How -- - The Modern Motor Carrier,** Terre Haute, Ind.: Eastern Express Inc., 1966 (16 mm, sound, 28 minutes).

EQUIPMENT:

16 mm projector, overhead projector and screen.

PRIMARY REFERENCES:

1) Flood, K. U., **Traffic Management,** Dubuque, Iowa: Wm. C. Brown Company, 1963.

2) Taff, Charles A., **Management of Traffic and Physical Distribution,** Homewood, Illinois: Richard D. Irwin, Inc., 1964.

3) Van Houten, J. C. and Clevenger, C. E., **Essentials of Modern Transportation for Colleges.** Dubuque, Iowa: Wm. C. Brown Company, 1957.

I. INTRODUCTION and MOTIVATION

A. Prepare a packet of bills of lading forms, waybills, arrival notices, receipts, freight bills and the essential business papers that accompany a typical shipment of goods so that students can see the amount of paper work that is needed for what appears to be a simple process of transporting goods from point A to point B.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Commercial Bills of Lading.	1. The document that originates the shipment. Contains all information for handling shipment in transit, protection, and delivery information.	
1. Straight Bill of Lading	2. Non-negotiable. Contains statement that goods are consigned to specified consignee.	
2. Order Bill of Lading	3. States that goods are consigned to the "order" of person named in the Bill and is negotiable.	
	4. Order Bill of Lading procedure.	
	5. Lost or delayed Bill of Lading.	
	6. Securing payment before delivery. Order Bill of Ladnig vs. C. O. D.	
	7. Shipper's special form.	
	8. Short form Bill of Lading.	
3. Function of the Bill of Lading	9. Three distinct functions: a. Receipt for goods b. Contract of carriage c. Documentary evidence of title	
	10. "Without recourse" clause.	
B. Special types of Bills of Lading.	1. Three types of Bills of Lading. a. Uniform through export b. Uniform domestic c. Uniform livestock contract	
1. Uniforms through export Bllis of Lading.	2. Divided into three parts: a. Movement from interior point to port and delivery to vessel b. Ocean transport from port of export to foreign port c. Transport from foreign port to destination	
	3. Procedure for issuing.	
2. Uniform livestock contract	4. Use "straight" livestock contract.	
	5. Difference between "straight" Bill of Lading and "straight" livestock contract.	
3. Other rail and motor Bills of Lading	6. Regular, alternate, and straight forms.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Accouting procedures and forms. 2. Budgeting procedures. 3. Line items on budgets. 4. Understanding function of accounting machines. 5. Selecting mode or carrier based on comparative cost for services rendered. 6. Comparison of weekly, monthly, and annual salaries of personnel directly involved in documentation of transported goods.	1. Understanding abbrevations used on Bill of Lading forms and other documents in traffic management. 2. Reading and interpreting insurance and claim forms. 3. Importance of "fine print" on documents. 4. Monthly and quarterly reporting. 5. Comparsion of government and commercial forms.	1. Documentation and "red tape." Its impact on shippers and the general public. 2. Occupations involved in documentation of goods for transport. 3. General skills and qualifications of employees and employers in traffic management and physical distribution.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	7. Uniform straight, uniform order, uniform through export, and straight bill.	
4. Ocean Bills of Lading	8. Similar to rail and motor.	
	9. Differences in terms and conditions.	
5. Air Bills of Lading (air bill).	10. Non-negotiable, no specified uniformity, requires shipper to prepare and present air bill to carrier at time of shipment.	
6. Pipelines	11. No prescribed Bill of Lading, pipelines use "tender of shipment" which is non-negotiable.	
7. Express forms	12. Uniform express receipts are of two types: a. Collect form b. Prepaid form c. (Both are non-negotiable)	
8. Freight forwarders	13. Surface freight forwarders.	
	14. Forms of Bills of Lading for rail and motor transport.	
C. Government Bills of Lading.	1. Two basic forms. a. Shipping document, or invoice of receipt b. Bill of Lading	
	2. Government Bill of Lading serves as: a. Receipt for goods b. Shipping order c. Notice of loss or damage d. Contract of carriage e. Carrier's waybill f. Delivery receipt g. Description tally h. Freight bill	
	3. Preparation of government Bill of Lading.	
	4. Accountability of government Bills of Lading.	
	5. Conversion of commercial Bills of Lading to government Bills of Lading.	
D. Other transit documents.	1. Facilitates movement of freight.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
1. Waybill	2. Contains origin station, destination, routing, car initals and unmber, consignor and consignee, description of articles, weight, rate, freight charges, any specific instructions.	
2. Arrival notice	3. Sent to consignee and serves as basis for demurrage or detention action.	
3. Delivery receipt	4. Similar to freight bill, used for record of delivery as well as for possible future claim.	
4. Freight bill	5. Contains information in bill of lading and shows total freight charges.	
	6. Variation in freight bill format by modes.	
E. Accounting.	1. Acccunting areas in motor transport. a. Revenue b. Payables c. Statistics d. Maintenance e. Payrolls	
	2. Typical accounting forms. a. Freight bill register b. Daily traffic analysis of shipments c. Shipper anaylsis d. Accounts receivable summary e. Cash report f. Claim summary g. Statistical analysis card h. Claim prevention statistics i. Labor-material card j. Terminal expense k. Payroll register l. Withholding statement m. Vehicle operation and maintenance records n. Ledger o. General expense summary p. Comparative operating expense	
F. Business papers.	1. Examples of business papers in motor freight. a. Monthly reports of driving time	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

II. PRESENTATION of INTEGRATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	RELATED CONCEPTS SCIENCE
	b. Cause and commodity reports c. Daily manifests d. Trip report e. ICC quarterly reports f. Inspection reports g. Loss and damage claim h. Monthly balance sheet, etc.	
G. Data processing and systems to faciliate paper work.	1. Computerization of standard forms and accounting. 2. Department of Defense programs. a. MILSTRIP b. MILSTAMP	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES

III. APPLICATION

A. Spend time reviewing the basic and most essential forms for students then allow them to make out the actual documentation necessary for transporting goods from and to locations the teacher may designate.

IV. EVALUATION CRITERIA GUIDELINE

1. What are the most commonly used forms of a bill of lading?
2. What is the difference between commercial and government bills of lading?
3. Name a few special documentation forms in addition to bill of lading.
4. What are the implications of data processing in facilitation of paper work? Employees? Operational costs?

V. SUMMARY

A. Documentation is essential to shippers for records, contracts, terms and conditions, claims, demurrage, insurance, rates, routing and delivery of goods. Data processing equipment is gradually taking over many accounting and processing procedures.

VI. SUGGESTED TIME and SEQUENCE LISTING

40 minutes . . . Presentation of documentation forms.

180 minutes . . . Role playing experiences with filling out forms and accounting procedures.

140 minutes . . . Related concepts in science, math, communications and social studies.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) American Trucking Association, **The Motor Carrier Freight Claim Rule Book**, Washington, D. C.: The Association, 1957.

2) Case studies from companies involving loss or damage claims.

3) Douglas, P. S., "Transportation Paper Work Costs: Something Can Be Done," **Transportation and Distribution Management**, July 1969, pp. 41-45.

4) Sample documentation forms (blank and filled in) from the five modes.

INSTRUCTOR'S UNIT PLAN

Unit 8
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **In-Plant Materials Handling and Packaging**

AIM: To develop a knowledge of in-plant materials handling and packaging and to gain experience with materials handling systems, facilities and vehicles used.

INSTRUCTIONAL AIDS:

Filmstrip - **Looking at Business Careers.** New York: McGraw-Hill Text Films, 643000 series (35 frames, $6.50).

EQUIPMENT:

Pallets, platform truck, forklift truck, roller and wheel conveyors, hand trucks and assorted boxes of various sizes and shapes.

PRIMARY REFERENCES:

1) Heskett, J. L., Ivie, R. M. and Glaskowsky, N. A., **Business Logistics.** New York: The Ronald Press Company, 1964.

2) Taff, C. A., **Management of Traffic and Physical Distribution.** Homewood, Illinois: Richard D. Irwin, Inc., 1964.

I. INTRODUCTION and MOTIVATION

A. Have students visit the food storage facilities and general receiving area at the Institution. Discuss how materials are brought in, processed and stored for shipment or use. Raise thought provoking questions such as: About what percent of goods being handled here are damaged? How much does this cost the institution? How can this system be improved, i. e.? What devices or procedures would you add or change in this system to make it more efficient?

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Definition of materials handling.	1. Preparation, placing, and positioning of materials to facilitate their movement or storage.	
B. Purpose of materials handling and packaging.	1. Goals established by American Materials Handling Society: a. Reduce cost b. Increase capacity c. Improve working conditions d. Improved distribution	
C. Measuring efficiency in materials handling.	1. Measuring efficiency of materials handling. 2. Classes of materials handling. a. Unit materials b. Bulk materials c. Parts	
D. Equipment used in materials handling.	1. Factors to consider in the selection of equipment. 2. Types of equipment used: a. Belt conveyors b. Overhead cranes c. Hoists d. Industrial trucks e. Power shovels f. Roller Conveyors g. Freight elevators h. Straddle carriers i. Monorails j. Handlift trucks k. Trolley conveyors l. Forklift trucks m. Platform trucks	
E. Palletization.	1. Advantages of palletization. 2. Types of pallets. a. Design b. Construction	
F. Containerization.	1. Types of containers. 2. Advantages of containerization. 3. Impact of containerization on transportation service. 4. Standards for containers.	
G. Industrial packaging.	1. Two types of packaging: a. Industrial b. Consumer 2. Packaging materials.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Influence of materials handling on improving working conditions.
1. Importance of efficiency in terms of cost. a. Compare the efficiency of manual handling operation to an equipment handling operation b. Calculate the efficiency lost by inoperative equipment	1. Structuring experimental or survey research on materials handling equipment to determine efficiency and usefulness to home plant.	
1. Cost factors in equipment selection. a. Compare purchase and operating cost of various materials handling equipment b. Prepare a chart to illustrate the above comparison	1. Ordering and receiving materials handling equipment. 2. Specifications listing.	1. Development of machinery and equipment in materials handling and its effects on labor supply and demand.
	1. Nomenclature assigned to pallets and containers for industrial use.	1. Study of pallet industries in terms of jobs, positions, and responsibilities.
1. Standard sizes and shapes of containers and storage area needed. a. Describe the various package shapes b. Compare the volumes of cylinders and rectangular solids		
1. Cost of packaging compared to price of product	1. Selection of appropriate terminology and reading level of package design. 2. Communications by color and space on package.	1. Effects of advertising and packaging on the consumer. 2. Study of the production of packages and packaging procedures.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	a. Hard . . . wood, plastics, fiber, masonite, glass, and metals b. Soft . . . paper, laminated products, fabrics, and styrofoam 3. Package design and construction. 4. Factors affecting package design.	
H. Loading and unloading.	1. Purpose to prevent damage and loss. 2. Unitization of products (combining packages into larger container). 3. Docking and unloading facilities designed to reduce damage. 4. Mechanical loading and unloading.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Cost of manual vs. mechanical labor to load and unload shipments.	1. Attitudes of workers and their effects on loss or damage during loading and unloading. 2. Identification of merchandise as it is loaded or unloaded.	1. Strength of unions in preventing or enhancing progress in materials handling systems.

III. APPLICATION

A. Students should spend a full day in a plant loading and unloading goods and using materials handling equipment and machinery to gain experience and skill in their use. Students can also experiment with different ways of handling merchandise to see which seems most efficient in the "short run" and "long run".

IV. EVALUATION CRITERIA GUIDELINE

1. What is materials handling?

2. How can you equate in-plant materials handling to match flow of goods entering and leaving the plant?

3. What basic equipment is needed to start a materials handling system?

V. SUMMARY

A. Materials handling is the preparation, placing and positioning of merchandise to facilitate its movement or storage. In-plant handling must be tuned to production schedules and physical supply and distribution.

B. Packaging and containerization have made goods handling more efficient and less costly.

VI. SUGGESTED TIME and SEQUENCE LISTING

60 minutes . . . Tour of in-plant handling facilities.

300 minutes . . . Experiences with materials handling equipment and facilities to develop skills in their use and maintenance.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Immer, J. R., **Materials Handling**, New York: McGraw-Hill Book Company, Inc., 1953.

2) **Modern Materials Handling Magazine.**

3) Morris, W. T., **Analysis for Materials Handling Management**, Homewood, Illinois: Richard D. Irwin, Inc., 1962.

4) Oliphant, H. D., **Materials Handling Applications**, Philadelphia: Chilton Book Company, 1958.

5) Oliphant, H. D., **Materials Handling Equipment**, Philadelphia: Chilton Book Company, 1957.

INSTRUCTOR'S UNIT PLAN

Unit 9
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Warehousing and Inventory Control**

AIM: To develop an understanding of warehouse location, inventory, operation and control and to gain experiences in warehousing operations.

INSTRUCTIONAL AIDS:

Charts - Showing warehouse layout and zones, pallet storage patterns, traffic flow and work stations.

EQUIPMENT:

Sample IBM inventory cards, stock order forms, accounting and inventory forms. Materials handling equipment.

PRIMARY REFERENCES:

1) Briggs, A. J., **Warehouse Operations Planning and Management,** New York: John Wiley and Sons, Inc., 1960.

2) Gecowets, G. A., "How to Understand Warehousing Even If You're Not a Warehouseman," **Handling and Shipping,** 1962, pp. 28-30.

3) Heskett, J. L., Ivie, R. M. and Glaskowsky, N. A., **Business Logistics,** New York: The Ronald Press Company, 1964.

I. INTRODUCTION and MOTIVATION

A. Use the following quote to open lesson: " . . . For lack of a science of 'short range' transportation, thousands of factories and distribution activities have been paying extra and unnecessary costs." (See James Bright at end of unit).

B. Warehouse operation and carrying costs amount to six percent of the gross national product and inventory control is the heart of the logistics function.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. The nature of warehousing. 1. Materials handling warehouses	1. Main purpose is to assemble, mix, and segment goods in transit. 2. Basic types of materials handling warehouses. a. Assembly warehouses b. Distribution warehouses 3. Primary concern is movement of goods. Serve as storage-in-transit point. 4. Layout of materials handling warehouse.	
2. Storage warehouses	5. Main purpose is to mature, ripen, or age products of various kinds and stockpiling of products due to seasonal demand, labor disputes, inclement weather, and purchasing peaks. 6. Layout of storage warehouse facility.	
3. Combination warehouses	7. Most common . . . combines storage and materials handling operations.	
B. Determining warehouse facilities.	1. Business firms have three alternatives for selecting a warehouse facility: a. Private warehouse (owned) b. Private warehouse (leased) c. Public warehouse 2. Characteristics of private warehousing. a. Greater flexibility of use b. Better control of operation c. Usually located closer to plant 3. Characteristics of public warehousing. a. No investment b. Normally less expensive per unit cost c. Greater flexibility in inventory location 4. Railroad side lines. 5. Truck docking facilities.	
C. Warehouse materials handling systems.	1. Categories of materials handling systems:	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Cost estimates of warehousing facilities. 2. Computation of construction and utilities cost used to determine location of warehouses.	1. Recongnizing and reading labels 2. Preparing shipping instructions for movement of goods.	1. The significance of materials handling and distribution warehouses to industry and the consumer. 2. Warehouse management and employee levels.
1. Land values. 2. Leasing vs. purchasing. 3. Taxes and fixed cost. 4. Interest on loans and financial negotiations. a. Calculate interest payable on loans. b. Calculate intrest using . . . amortization schedules	1. Gathering basic research data on available sites.	1. Industrial zoning.
1. Equipment costs. a. Initial b. Repair c. Depreciation d. Operation	1. Applying for job in warehouse.	

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	a. Individually powered vehicles such as forklift trucks, towing tractors, cranes, hand powered equipment, and miscellaneous equipment. Powered vehicles used batteries, gasoline, diesel fuel, or gas b. Conveyors . . . roller and wheel type c. Containers and unitization of freight including pallets, bins and drawers, typing devices, and various containers. d. Storage aids such as vertical dunnage e. Pallet storage patterns 2. Facility layout. a. Materials flow b. Storage area c. Isle width d. Zoning e. Out-and-back section f. Order-picker system g. Conveyorized system h. Rotation of stock 3. Providing customer service.	
D. Automated warehousing.	1. Electronic equipment. 2. Monitoring and controls. 3. Semi-automated warehouses.	
E. Inventory control.	1. Types of inventory. a. Product b. Item c. General 2. Stockout. 3. Inventory control systems. a. "Trigger principle" b. Fixed reorder point c. Optimum order quanity d. Fixed order interval e. Electronic inventory data processing	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Standard package or carton sizes. 2. Standard pallet sizes.	1. "Breaking in" new employees.	1. Boundaries of union supervision and control in warehousing.
1. Costs of labor vs. electronic equipment. a. Breakage		1. Attitudes of union officials toward automated warehousing.
1. Inventorying checking and accounting systems. 2. Marketing and sales analysis and forecasting data systems. 3. Stockout costs. 4. Inventory control formulas.		1. Effects of marketing and sales forecasts on warehousing and inventory control.

III. APPLICATION

A. Students should work in a warehouse during the six hours allocated for this lesson so that they will experience receiving, materials handling, storage, shipping, etc., operations to grasp an understanding of the total warehouse and inventory control function.

IV. EVALUATION CRITERIA GUIDELINE

A. What skills are required of employees in warehousing and inventory control systems?

B. How are inventory costs determined?

C. How is warehouse type and location determined?

D. What is the responsibility of the warehouse manager?

V. SUMMARY

A. Review warehouse types, operations and materials handling systems. Point out relationship of marketing and sales forecasts with production, distribution, and inventory control. Review stockout prevention systems.

VI. SUGGESTED TIME and SEQUENCE LISTING

180 minutes . . . Unloading, receiving and storing products in warehouse.

100 minutes . . . Managerial experiences with directing warehouse operations, accounting, stock ordering and inventorying.

80 minutes . . . Practice with inventory control systems.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Bowersox, D. J., Smykay, E. W. and Mossman, F. H., **Physical Distribution Management,** New York: The Macmillan Company, 1961.

2) Frederick, J. H., **Using Public Warehouses,** Philadelphia: Chilton Book Company, 1957.

3) Frock, R. J. and Morehouse, J. E., "Controlling Local Delivery Costs with CARD," **Transportation and Distribution Management,** June 1969, pp. 47-52.

4) Johnson, R. J., **Personnel and Industrial Relations,** Homewood, Illinois: Richard D. Irwin, Inc., 1960.

5) Magee, J. F., **Production Planning and Inventory Control,** New York: McGraw-Hill Book Company, 1958.

6) Starr, M. K. and Miller, D. W., **Inventory Control: Theory and Practice,** Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1962.

7) **Transportation and Distribution Management,** January 1969 issue.

8) Yaseen, L. C., **Plant Location,** New York: American Research Council, Inc., 1956.

INSTRUCTOR'S UNIT PLAN

Unit 10
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Terminal Facilities and Operations (Freight)**

AIM: To develop an understanding of the design and function of freight terminals and to gain basic skills in termianl operations.

INSTRUCTIONAL AIDS:

Filmstrip - **Silent Partner,** Kansas City, Mo.: Butter Manufacturing Company.

Charts - Terminal designs and layouts in airports, harbors, rail stations, motor transport and tank farms.

Film - **Air Cargo - - A Modern Marketing Tool,** East Hartford, Conn.: United Aircraft Corporation, 1964 (16 mm, sound, 29 minutes).

Film - **Alabama State Docks at the Port of Mobile,** Mobile, Alabama: Alabama State Docks (16 mm, sound, 15 minutes).

Film - **Of Ships and Cargo,** Portland, Oregon: Portland Public Docks, 1960 (16 mm, sound, 18 minutes).

Film - **Sixty Seven South,** New York: Port Authority, 1961 (16 mm, sound, color, 25 minutes).

EQUIPMENT:

Filmstrip projector, 16 mm projector, screen, terminal facility and materials handling equipment.

PRIMARY REFERENCES:

1) Hay, W. W., **Introduction to Transportation Engineering,** New York: John Wiley & Sons, Inc., 1961.

2) **Manual for Planning and Operating Terminals.** Washington, D. C.: American Trucking Association, 1954.

3) Van Houten, J. C. and Clevenger, C. E., **Essentials of Modern Transportation for Colleges,** Dubuque, Iowa: Wm. C. Brown Company, 1957.

I. INTRODUCTION and MOTIVATION

A. A terminal is very important to the successful operation of any transportation service. A poorly planned terminal affects profit margins, morale and over-all operating efficiency.

B. Show filmstrip: **Silent Partner;** discuss terminal operations and facilities.

II. PRESENTATION of INTEGRATED CONCEPTS

	RELATED CONCEPTS	
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Terminal design.	1. Generally "L," "T," or "U" shape. 2. Factors to consider in terminal design and operation: a. Selecting location b. Estimating space needed c. Crossdock area d. Office facilities e. Apron space and parking f. Grading and paving g. Lighting, heating, ventilation h. Communication system i. Exposure to weather	
B. Terminal characteristics.	1. Operational characteristics. a. Turn-around time b. Terminal cost c. Accessibility d. Appearance e. Dock position and approach f. Dock design and construction 2. Materials handling equipment. 3. Types of traffic. 4. Transit shed. 5. Ports and harbor requirements. for shipping. 6. Yard functions. 7. Airport terminal requirements. 8. Tank farm network.	
C. Terminal operations.	1. Loading and unloading. 2. Weighting and packaging. 3. Marking and checking. 4. Dispatching. 5. Route loading. 6. Zone loading. 7. Peddle trips. 8. Short runs. 9. Platform costs. 10. Service and maintenance. 11. Freight handling. 12. Spotting. 13. Records and inventories.	1. Theory of displacement and buoyancy.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Determining cost of construction and operation of freight terminals. 2. Calculate space allocation using area formulas.	1. Planning and gathering data for terminal construction. 2. Tri-state transportation study report (New York, New Jersey, and Connecticut). 3. Communications systems.	1. Trends in terminal architecture and their effects on "public image." 2. Locations of terminals in terms of: a. Geography b. Population centers c. Resources 3. Port of Authority organization and function.
1. Estimating time lost in turnaround, switching, and sorting. 2. Figuring water depth and vessel draft. 3. Dock length. 4. Safe distances for vehicles to approach docking or terminal facilities.		
1. Weight scales. a. Pound b. Ton c. Ton miles d. Gross weight e. Net weight f. Taxable weight g. Displacement estimate	1. Manager-employee relations. 2. Accuracy needed in checking, dispatching, freight handling, and record keeping.	1. Comparison of terminal characteristics and operations in the basic modes. a. Air b. Motor c. Rail d. Water e. Pipeline

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	14. Special customer services. 15. Longshoremen. 16. Customs offices. 17. Tugmen. 18. Monitors.	
D. Frieght forwarders (review).	1. Air freight forwarders. 2. Surface freight forwarders.	
E. Mail services.	1. Air mail operations. 2. Railroad and motor carrier mail operations.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		1. Development of air mail service. 2. Mail sorting and distributing systems: a. At post office b. In route

III. APPLICATION

A. Students should be divided into groups and assigned to work in two or more terminals serving different modes. At least one full day should be spent at each terminal to allow students to observe and participate in the basic terminal operations.

IV. EVALUATION CRITERIA GUIDELINE

A. What appears to be the most important terminal functions in general? For each mode?

B. Layout a motor carrier terminal.

C. Identify the various job classifications normally used in terminal operations.

V. SUMMARY

A. Basic terminal shape and layout is important to the industry since the terminal is the "crux" of the transportation system. A general goal in terminal operations is to improve efficiency of freight handling.

VI. SUGGESTED TIME and SEQUENCE LISTING

60 minutes . . . Terminal design and characteristics.

300 minutes . . . Experiences in terminal operations.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) **Financing and Forecasting Needs of Motor Carrier Terminals,** Evanston, Illinois: Northwestern University Transportation Center, 1960.

2) General information on terminal operations is available through the Terminal Operations Council, American Trucking Association, Inc.

3) "Guidelines for Laying Out a Truck Dock," **Transportation and Distribution Management,** June 1969, pp. 35-43.

4) Mayer, H. M., **The Port of Chicago and the St. Lawrence Seaway,** Chicago: University of Chicago Press, 1957.

5) **Methods of Freight Handling,** Washington, D. C.: American Trucking Association (booklet).

6) **Role of Air Freight in Physical Distribution, The,** Boston: Division of Research Graduate School of Business Administration, 1956.

7) Sauerbier, C. L., **Marine Cargo Operations,** New York: John Wiley and Sons, Inc., 1956.

8) **What Do You Know About Trucks?,** Detroit: Automobile Manufacturers Association (booklet).

INSTRUCTOR'S UNIT PLAN

Unit 11
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Terminal Facilities and Operations (Passenger)**

AIM: To develop an understanding of the design, layout and function of passenger terminals and to gain some skills in basic terminal operation.

INSTRUCTIONAL AIDS:

Filmstrip - **Using Travel Services.** New York: McGraw-Hill Text Films (35 frames).

Film - **The Other Passenger (FA-601),** Oklahoma City, Oklahoma: Federal Aviation Agency, 1965 (16 mm, sound, 30 minutes).

Film - **The Airport Jam** (BS-911), Ridgefield, New Jersey: Association Films, Inc. (16 mm, sound, 26 minutes).

Film - **Transportation by Ship.** Los Angeles, California: Bailey Films (super 8 mm, sound, color, 11 minutes, cost $89.00).

Transparencies - Teacher-made showing terminal layout and passenger flow.

EQUIPMENT:

Super 8 mm projector, 16 mm projector, 35 mm projector, screen, terminal facilities and equipment.

PRIMARY REFERENCES:

1) Frederick, J. H., **Commercial Air Transportation.** Homewood, Illinois: Richard D. Irwin, Inc., 1961.

2) The Port of New York Authority, **A Plan for a New Consolidated Passenger Ship Terminal in the Port of New York.** New York: The Port Authority, 1967.

3) **World Book Encyclopedia,** Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Show film: **The Airport Jam** and begin discussion of passenger terminal facilities: Whether they are able to handle the passenger load or not. If so, how? If not, how should terminals be improved?

B. Discuss deterioration of urban train and bus terminals.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Terminal design and layout.	1. Provisions for: a. Passenger arrival and departure b. Parking (long and short term) c. Loading and unloading of cars, taxis, and limousines d. Baggage sorting and handling e. Lounge areas f. Eating facilities or coffee shops g. Space for visitors to meet passengers h. Office and maintenance spaces i. Customs area j. Car rental k. Stores and newstands l. Public washroom facilities m. Storage n. Elevators, conveyors, and escalators o. Ticket and reservation areas p. "Ready rooms" for drivers, pilots, and crews q. Waiting rooms	
B. Supporting operations.	1. Reservations handling. a. Computer systems 2. Scheduling: a. Coaches b. Trips c. Passengers 3. Ticket and information services. 4. Routing. 5. Weather forecasting and reporting. 6. Passenger boarding systems. 7. Security checks. 8. Airport management and maintenance.	
C. Specific passenger terminal requirements.	1. Air terminals: a. Control tower b. Hangers for storage and maintenance. c. Runway designation and identification	1. Meteorology and weather: a. Cloud formations b. Precipitation forms c. High and low pressure systems d. Movement of air masses

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Surveys of community needs for terminals (air, ship, motor and rail).	1. Contracting for construction and rehabilitation of terminals. 2. Leasing procedures and legal obligations. 3. Land requisition and purchase. 4. Air pollution around airports.
1. Pricing policies. 2. One way and round trip costs.	1. "Handling the general public": importance of attitudes, services, and good public relations.	1. Trends in passenger terminal designs. 2. Problems with inner city passenger terminals.
1. Financing terminal operations. 2. Cost of services in modern high speed trains. 3. Cost comparison of air, ship and rail transport.	1. Reporting to federal agencies. 2. Handling customs operations.	1. Government supervision and control of air terminal operations. 2. Federal legislation affecting terminal operations. 3. Importance of private aircraft traffic. 4. Shuttle service from terminal to downtown.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
	b. Meterologist stations e. Lighting and landing aids f. Private aircraft facilities 2. Ship terminals: a. Waterfront docking b. Tugboat assistance c. Pier consideration for tidal changes d. Helicopter and/or VTOL service 3. Rail and motor terminals: a. Nearness to downtown business and shopping areas 4. Elevated terminals. a. Electric trains b. Commuter trains 5. High speed rail terminals.	2. Tidal characteristics. a. Moon and sun's effect on tides b. Other factors influencing tides

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
		5. Emerging high speed trains and their effect on terminal design and operation.

III. APPLICATION

A. Students should spend a minimum of two full days observing and participating in basic terminal operation to develop an over-all cognizance of these operations and begin to develop some skills in these areas.

IV. EVALUATION CRITERIA GUIDELINE

A. Where are terminals generally located? (Rail, ship, air and motor).

B. What basic services should passenger terminals provide?

C. What special requirements are needed in each model terminal?

V. SUMMARY

A. Passenger terminal operations need to be designed to provide comfort, convenience and auxiliary services for passengers during their use of the facilities. Employees should convey an attitude of confidence and trust and willingness to assist the passengers.

VI. SUGGESTED TIME and SEQUENCE LISTING

40 minutes . . . Show film and discuss terminals.

320 minutes . . . Work at a passenger terminal to gain experience in various terminal operations.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) American Municipal Association, **The Collapse of Commuter Service: A Threat to the Survival of America's Metropolitan Areas.** Washington, D. C.: The Association, 1960.

2) Colt, S., "240,000 Riders Use Bus Terminals Daily," **Westsider,** Summer, 1964, p. 42-43.

3) Curtiss, R. S., "The Port Authority Bus Terminal," **Skyscraper Management,** January 1952, p. 6-9.

4) Lukens, M. E., "America's Airports Face a Challenging Future," Remarks at American Association of Airport Executives Annual Luncheon, New York: May 17, 1960, p. 10.

5) **Official Register of Passenger Train Equipment,** New York: Railway Equipment and Publication Company (no date).

6) Olcott, E. S., "Ground Transportation Between City and Airport," **Airport Terminal Facilities;** ASCE-AOC1 Specialty Conference, Houston, Texas: April 10-14, 1967, p. 223-234.

7) Wood, D. J. D., "Air American Port Tour," **Dock and Harbor Authority,** January 1967, p. 268-270.

INSTRUCTOR'S UNIT PLAN

Unit 12
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Planning and Building Model Roadways**

AIM: To provide students with opportunities to develop basic skills in construction of basic ways for highway, rail, pipeline and water transport.

INSTRUCTIONAL AIDS:

Film - **AASHO Road Test: The Road to Better Roads,** Washington, D. C.: Federal Highway Administration, 1963 (16 mm, sound, color, 14 minutes).

Film - **Airfield Flexible Pavement,** Dallas, Texas: U. S. Army Engineer Division, 1955 (16 mm, sound, color, 54 minutes).

Film - **The American Road,** Dearborn, Michigan: Ford Motor Company (16 mm, sound, color, 38 minutes).

Film - **Asphalt Through the Ages,** College Park, Maryland: Asphalt Institute, 1957 (16 mm, sound, color, 13½ minutes).

Film - **The Better Way,** Chicago: Santa Fe Film Bureau, 1961 (16 mm, sound, color, 28 minutes).

EQUIPMENT:

16 mm projector, screen, samples of concrete, asphalt, models of subgrade, drainage, superstructures for study and actual facilities for developing skills will be needed.

PRIMARY REFERENCES:

1) Hay, W. W., **Introduction to Transportation Engineering,** New York: John Wiley and Sons, Inc., 1961.

2) Legault, A. R., **Highway and Airport Engineering,** Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1960.

3) Overman, M., **Roads, Bridges and Tunnels,** New York: Doubleday and Company, Inc., 1968.

4) **World Book Encyclopedia,** Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

Introduce film: **The American Road** and develop discussion of highway construction. Compare this with rail, water and pipeline ways.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Subgrades.	1. Function of subgrades. 2. Action under loads. 3. Soils. 4. Design for stability and adequate bearing capacity. 5. Canals. a. Side slope stability b. Preventing water loss 6. Pipelines. a. Soil conditions	1. Effects of pressure,strians, and weight on materials. 2. Soil characteristics. 3. Cushioning effects of soil. 4. Acidic actions of various types of soil.
B. Drainage.	1. Relation to subgrade. 2. Drainage design. a. Formulas for determining drainage design 3. Subdrainage.	1. Specific gravity of water. 2. Rates of flow and designs to accommodate flow. 3. Effects of moisture on subgrades.
C. Roadway superstructures.	1. Railroad track. a. Ties and rails b. Anchoring tracks c. Ballast 2. Pavement. a. Flexible type b. Rigid type c. Materials used d. Macadam road 3. Lanes. a. Sizes and shouldering	1. Chemical preservatives on rail ties. 2. Ballast materials. 3. Abrasive stresses on roadbeds. 4. Principles of compression and sheer. 5. Principles of compression and tensile stresses. 6. Thermal stresses.
D. Waterways.	1. Natural waterways. a. Channeling 2. Canalized rivers. 3. Navigation locks. 4. Man-made canals.	1. Water errosion effects. 2. Dredging principles. 3. Principles of lock operation. 4. Soil composition of reclaimed land.
E. Machinery and equipment used in roadway construction and maintenance.	1. Major construction equipment. 2. Maintenance equipment.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Formulas for determining stress, capacity, sheer, and strength factors.	1. Reading and understanding technical information. 2. Relationships of foreman and work crews; supervisor and foreman; manager and owner.	1. Opportunities in transportation facilities planning and construction. 2. Contracting estimates and procedures for roadway construction.
1. Surveying and measuring.	1. Handling customer complaints from contracted jobs.	1. Impact of unions of employee hiring and firing.
1. Lane sizes and allowances. 2. Thickness of surface materials. 3. Allowing for expansion and contraction.	1. Ordering materials for subgrades and superstructures.	1. Problems of previous railroad "featherbedding."
1. Channel depths. 2. Measuring water pressure and weight.	1. Organizing and directing workers.	1. Effects of improved waterways on transportation systems.
1. Costs of machinery and operators per hour, per job, annually.		1. Changes in job requirements and titles as a result of modern machinery.

III. APPLICATION

A. Students should visit or plan and develop a highway construction project to gain actual experiences on the job. A small bridge, channel, lock or airstrip could also be built.

IV. EVALUATION CRITERIA GUIDELINE

A. How does airport runway thickness compare with roadway thickness in concrete? Asphalt?

B. In what way are the problems of subgrade and canalway design and construction similar? Dissimilar?

C. What materials are commonly used for subgrades and drainage?

D. What jobs are available in roadway construction?

V. SUMMARY

A. Highway, railway, seaway and pipeline trench construction and preparation are very similar. The important thing is to prepare the way or trench properly for a base and to select the appropriate materials for superstructure.

VI. SUGGESTED TIME and SEQUENCE LISTING

60 minutes . . . Show film and discuss highway construction.

180 minutes . . . Experiences with roadway theory and construction activities.

120 minutes . . . Related concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Booth, S. J., "The History of Federal Aid Legislation for Highways," **Golden Anniversary Book**, American Association of State Highway Officials, 1964.

2) Giles, J., **Bridges and Men**, New York: Grosset & Dunlap, Inc., 1963.

3) Hanson, H. W., "Guides for Transportation Planning," **Traffic Quarterly**, April 1962.

4) Kapp, M. S., et al., "Construction on Marshland Deposits: Treatments and Results," **Highway Research Record**, No. 133, 1966, pp. 1-22.

5) Kyle, J. M., "New Wharf Construction Methods in the Port of New York," **HANSA**, June 1, 1968, pp. 992-995.

6) "New York Port Authority's Snow Operations: How Clearing is Handled at PA's Airports, Bridges, Tunnels," **Constructioneer**, July 26, 1965, pp. 39-41.

7) Yang, N. C., "Condition of Large Caissons During Construction," Paper presented at annual meeting of Highway Research Board, Washington, D. C.: January 1964.

INSTRUCTOR'S UNIT PLAN

Unit 13
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Bridge, Dam and Tunnel Construction**

AIM: To develop experiences and basic skills in bridge, dam and tunnel construction.

INSTRUCTIONAL AIDS:

Film - **Billion Gallons a Day,** Los Angeles: Metropolitan Water District of Southern California 1964 (16 mm, sound, color, 27 minutes).

Film - **Bridge to the Future,** Washington, D. C.: Farm Film Foundation 1961 (16 mm, sound, color, 29 minutes).

Film - **John Fitzgerald Kennedy Memorial Bridge,** New York: American Institute of Steel Construction, Inc. (16 mm, sound, color, 28 minutes).

Film - **Men, Steel and a Bridge,** New York: American Institute of Steel Construction, Inc. (16 mm, sound, color, 30 minutes).

EQUIPMENT:

16 mm projector, screen, model section with earth and water, and general hand tools.

PRIMARY REFERENCES:

1) Giles, J., **Adventure Underground,** New York: Doubleday & Company, Inc., 1962.

2) Giles, J., **Bridges and Men,** New York: Grosset & Dunlap, Inc., 1963.

3) Overman, M., **Roads, Bridges and Tunnels,** New York: Doubleday & Company, Inc., 1968.

4) Pequignot, C. A., **Tunnels and Tunneling,** New York: The Macmillan Company, 1963.

5) **World Book Encyclopedia,** Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Show class some of the details and facts of famous bridges, tunnels and dams. Discuss the reasons and advantages of these structures in the transportation network.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Bridge planning.	1. Bridge types. a. Beam b. Arch c. Suspension d. Composition e. Movable 2. Materials. 3. Foundations. a. Anchorage 4. Research.	1. Selection of proper materials for particular construction. 2. Making soil test. 3. Analysis of concrete used in bridge construction.
B. Bridge construction.	1. World famous bridges. 2. Bridge foundations. 3. Construction procedures for: a. Beam bridges b. Cantilever bridges c. Suspension bridges 4. Building steel arches. 5. Concrete arches.	1. Development of "waterproof" concrete. 2. Review of principles of stress, sheer, elasticity, compression, and tensile strength. 3. Effects of water on bridge foundations.
C. Dam construction.	1. Famous dams 2. Types of dams. a. Masonry types b. Embankment types c. Other types 3. Analysis of site and stream flow characteristics. 4. Planning reservoir outlets and spillways. 5. Building materials. 6. Hydroelectric dams.	1. Rock formations. 2. Characteristics of earth, stone, and steel in dam construction. 3. Effects of dams on wild life and fish. 4. Generation of hydroelectricity.
D. Tunnel design and construction.	1. Famous tunnels. 2. Surveying and planning a tunnel. 3. Survey by pilot tunnel. 4. Tunneling in rock. a. By machine 5. Tunneling through clay. 6. Tunneling under water. 7. Immersed-tube system.	1. Maintaining appropriate safe levels of ventilation in tunnels.

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Computing toll cost to cover bridge construction, maintenance, and operation.	1. Locating road signs and traffic control devices on bridges. 2. Drafting plans for bridges.	1. Research in bridge and dam construction. 2. Occupational opportunities in transportation construction.
1. Figuring volume of concrete. 2. Volume measurements. 3. Standard sizes of steel.	1. Read stories about famous bridges.	1. Factors in bridge design and construction. 2. Advantages and disadvantages of bridge types.
1. Tidal height and dam design.	1. Dam terminology and blueprints.	1. Effects of water back-up on land areas when dam is built. 2. Debate on Passamequaddy Project. 3. Dams as a source of power for underdeveloped nations. 4. Purpose of Tennessee Valley Authority. 5. St. Lawrence Seaway project.
1. Cost of tunneling compared to purchase of surface right-of-way.	1. Surveying charts and terms.	1. Costs of land acquisition as a factor which may send engineers underground to build super highways. 2. Changes in tunneling techniques.

III. APPLICATION

A. Students can work on model units or build an actual bridge, dam or tunnel to gain basic skills in planning and constructing these facilities. If on-the-job experience can be arranged, at least one full day should be spent on each facility.

IV. EVALUATION CRITERIA GUIDELINE

A. How do builders decide where to construct a dam? Bridge? Or tunnel?

B. What groups of occupations are involved in bridge and dam construction? Tunnel construction?

C. What construction materials are commonly used in constructing these three facilities?

V. SUMMARY

A. Highways, bridges, dams and tunnels are essential elements to any transportation system. Modern machinery has facilitated the construction of these elements. Since a great future is expected in transportation systems development there should be a growing need for skilled personnel.

VI. SUGGESTED TIME and SEQUENCE LISTING

45 minutes . . . Show film on bridge construction and relate facts on construction.

180 minutes . . . Experiences in constructing facilities.

135 minutes . . . Related concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Baumhoff, R. G., **The Dammed Missouri Valley,** New York: Alfred A. Knopf, Inc., 1951.

2) Hammond, R., **Tunnel Engineering,** New York: The Macmillan Company, 1959.

3) Rowe, R. E., **Concrete Bridge Design and Supplement,** New York: Contractor's Record, John Wiley & Sons, Inc., 1963.

4) Sandstrom, G. E., **Tunnels,** New York: Holt, Rinehart and Winston, Inc., 1963.

5) Shirley-Smith, H., **World's Great Bridges,** New York: Harper and Row Publishers, Inc., 1965, Second Edition.

INSTRUCTOR'S UNIT PLAN

Unit 14
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Traffic Control Systems (Highway)**

AIM: To develop an understanding of traffic regulation and control systems and to discover job opportunities in this field.

INSTRUCTIONAL AIDS:

Film - **The Thin Blue Line**, New York: Modern Talking Picture Service (16 mm, sound, 27 minutes).

EQUIPMENT:

16 mm projector, screen, sample traffic lights, model signs, highway sections, model cars and a two-way radio communication system.

PRIMARY REFERENCES:

1) Highway Research Board, "Trip Characteristics and Traffic Assignment," **Highway Research Board Bulletin**, 347, 1962.

2) Matson, T. M., Smith, W. S. and Hurd, F. W., **Traffic Engineering**, New York: McGraw-Hill Book Company, Inc., 1955.

3) Western, P. B., **The Police Traffic Control Function**, Springfield, Illinois: Charles C. Thomas, Publisher, 1960.

I. INTRODUCTION and MOTIVATION

A. Show film: **The Thin Blue Line** and discuss the role of a policeman. Work into discussion of control of traffic by police, pointing out the highway planning and engineering role in traffic control and regulation.

II. PRESENTATION OF INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Characteristics of highway and road use.	1. The road user. 2. The vehicle. 3. Speed. 4. Volume. 5. Origin and destination. 6. Steam characteristics. 7. Intersections. 8. Parking. 9. Accident characteristics.	1. Factors considered in road design: a. Condition of road surface b. Elevation of curves c. Drainage of road surface d. Effects of weather
B. Traffic regulation.	1. Basic considerations in traffic regulation. 2. Driver controls. 3. Vehicle controls. 4. General controls. 5. Speed controls. 6. One way streets. 7. Curb parking. 8. Miscellanous regulations.	
C. Control devices and aids.	1. Traffic control devices. 2. Traffic signs and marking. 3. Traffic signals. 4. Road lighting.	1. Devices as aids in traffic control: a. Traffic lights b. Timing devices 1) Electronic 2) Mechanical 3) Radar 2. Uses and composition of light reflecting materials. 3. Visibility of different colors.
D. Pedestrian safety.	1. Pedestrian regulation. 2. Pedestrain education. 3. Child pedestrians.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Number of passenger and freight miles traveled each year. 2. Accident statistics.	1. Communicating with the driver through signs, lights, painted lines on the highway, and other schemes.	1. History of highway traffic engineering and control. 2. Causes of increasing accident rates on U. S. highways. 3. Review of basic traffic studies in major urban areas. 4. Effects of stream characteristics on driving habits.
1. Stopping distances. 2. Estimating parking space size.	1. Traffic control reports from helicopter through radio station during rush hour traffic	1. Function of local and state police in traffic control. 2. Experimental use of urban traffic flow systems. 3. Highway engineering factors.
	1. Pedestrian safety education programs.	1. Review of pedestrian accidents and their causes. 2. Effects of alcoholism on driver-caused accidents.

III. APPLICATION

A. Students can arrange models in the lab to control traffic and to practice on making cordon counts, trip origination and destination surveys, examination and use of highway markers and giving traffic reports over communications systems.

IV. EVALUATION CRITERIA GUIDELINE

A. Identify some basic control devices used for automobiles, pedestrians.

B. What is the role of police, citizen in traffic control?

C. What are some trends or projections for traffic regulation and control?

V. SUMMARY

A. Traffic regulation and control is becoming more important today as increasing numbers of vehicles are registered and crowd the already inadequate highways. Accident rates are increasing to a point where serious regulation may restrict the auto driver much more than we realize today.

VI. SUGGESTED TIME and SEQUENCE LISTING

45 minutes . . . Film and discussion.
120 minutes . . . Traffic regulation and control devices and systems.
60 minutes . . . Pedestrian safety and control.
135 minutes . . . Related concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Hay, W. W., **Introduction to Transportation Engineering,** New York: John Wiley & Sons, Inc., 1961.

2) **Highway Research Board Bulletin Reports:**
a. "Highway Programming," Special Report #70, 1962.
b. "Highway System Classification," Report #42, 1959.
c. "Highway Capacity Manual," Special Report #87, 1965.
d. "Land Use in Traffic Generation," Bulletin 224, pp. 132-135, 1959.

3) **Penn Jersey Transportation Study:**
a. "Prospectus," December 1959.
b. Volume I, "The State of the Region," April 1964.
c. Volume II, "1975 Projections: Foreground of the Future," Sept. 1964.
d. Volume III, "1975 Transportation Plans," May 1965.

4) Pennsylvania Department of Highways, "A Typical Work Program for Phases I and II of Transportation Studies for Cities in Pennsylvania," Office of Planning and Programming, February 1964.

INSTRUCTOR'S UNIT PLAN

Unit 15
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Traffic Control Systems (Waterway, Railway and Airway)**

AIM: To develop an understanding of the various systems used to control traffic. To develop basic skills and experiences in one or more of the model control systems.

INSTRUCTIONAL AIDS:

Film - **Aids to Navigation,** Washington, D. C.: U. S. Coast Guard, 1959 (16 mm, sound, color, 22 minutes).

Film - **Plane Talk,** Local Bell System, Telephone Office, 1965 (16 mm, sound, color, 21 minutes).

Film - **A Trave[illegible]Meets Air Traffic Control (FA-102),** Oklahoma City, Oklahoma: Federal Aviation Administration, 1963 (16 mm, sound, color, 33 minutes).

EQUIPMENT:

16 mm projector, screen, model vehicles and signal system.

PRIMARY REFERENCES:

1) **Blue Jacket's Manual,** Annapolis, Maryland: The United States Naval Institute (latest edition).

2) Chapman, C. F., "Piloting, Seamanship and Small Boat Handling," New York: **Motor Boating,** 1970 edition.

3) Institute of Aviation, **Fundamentals of Aviation and Space Technology,** Urbana, Illinois: University of Illinois, 1962.

4) **U. S. Coast Guardsman's Manual,** Annapolis, Maryland: The United States Naval Institute (latest printing).

5) **World Book Encyclopedia,** Chicago: Field Enterprises Educational Corporation, 1970.

I. INTRODUCTION and MOTIVATION

A. Introduce topic by structuring a navigation problem using models of vehicles and navigational aids. Develop realization of need for navigational and control systems for traffic.

B. Have class recall traffic control systems they are already familiar with. Show film: **Aids to Navigation.**

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Waterway traffic controls. 1. Rules of the road	1. Piloting and safety. 2. Right of way. 3. Whistle signals. 4. Lighting.	1. Candlepower. 2. Effects of salt water and inland fresh water on navigational aids. 3. Identifiable characteristics of signals: a. Color codes b. Timing codes
2. Navigational aids	5. Lighthouses. a. Light characteristics b. Light list 6. Light ships. 7. Buoyage systems. a. Inland and Great Lakes b. Intracoastal waterways	
3. U. S. Coast Guard	8. Policing and control by Coast Guard and State bodies. 9. Maps and charts.	
B. Railway traffic controls. 1. Signals and safety devices	1. Block-signal system. a. Blocks b. Zones 2. Interlocker signal system. 3. Centralized traffic control. 4. Other signals. a. Fixed b. Whistle c. Hand, flag, and lamp d. Train	
C. Air traffic control. 1. Communications	1. Aircraft communication. a. Radiotelephones b. Morse Code 2. Light signals. 3. Flight controls (ARTC). a. IFR b. VFR c. Omni radio (VOR) 4. Flight plans.	1. Meterology and weather. 2. Celestial bodies and their use in navigation. 3. Principles of radar: a. Radar signal b. Doppler effect c. Timing in microseconds
2. Air navigation	5. Four forms of air navigation. a. Pilotage b. Dead reckoning c. Radio d. Celestial 6. Maps and charts.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Calculate position by triangulation.	1. Understanding lights and navigational aids. 2. Reading such publications as: a. LIGHT LIST b. NOTICE TO MARINERS 3. Reading ocean charts.	1. Responsibilities of the boat pilot. 2. Effects of color on communications of navigational aid. 3. Functions of U. S. Coast Guard.
	1. Reading and interpeting railroad signal systems.	1. Transition from hand signals to centralized traffic control.
1. Timing of flashing lights. 2. Frequency settings. 3. Plotting a course, figuring ground speed, air speed, compass correction, compass heading, etc.	1. Reading air maps and charts. 2. Morse Code. 3. Reading light signals. 4. Reading coded weather reports.	1. The importance of accurate air traffic control. 2. Federal Aviation Agency and its intrest in air traffic control.

III. APPLICATION

A. Students should be able to spend one or more days with the Federal Aviation Agency, the U. S. Coast Guard and a railroad central signal system. For this unit, the class can work with models to gain an understanding of traffic control in the various modes, then go out on the actual job.

IV. EVALUATION CRITERIA GUIDELINE

A. What are the functions of Air Route Traffic Control (ARTC)?

B. How have railroads automated their traffic control systems?

C. Explain the basic buoyage patterns for inland and Great Lakes waters.

D. Which of the modal systems seemed to be more highly controlled?

V. SUMMARY

A. Traffic is regulated and controlled by a system of signals, whistles, lights, buoys, radio-telephone, VOR and other navigational aids. Traffic control usually causes some delay but results in more efficient traffic flow.

VI. SUGGESTED TIME and SEQUENCE LISTING

45 minutes . . . Review and discuss film: **A Traveler Meets Air Traffic Control.**

60 minutes . . . Work with models of vehicles and navigational systems.

180 minutes . . . Actual traffic control experiences in a center.

75 minutes . . . Related concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) **American Railway Engineering Association Manual,** Chicago: The Association, Construction and Maintenance Section, Loose-leaf.

2) Association of American Railroads, **American Railway Signalling Principles and Practices,** Chicago: The Association, Signal Section Revisions by Chapter.

3) Association of American Railroads, **The Standard Code of Operating Rules, Block Signal Rules, Interlocking Rules,** Washington, D. C.: The Association, Operations and Maintenance Department, 1953 with revisions.

4) Coast and Geodetic Survey, **Tide Tables, Current Tables, Tidal Current Charts, Coast Pilots,** Washington, D. C.: U. S. Department of Commerce (current issue).

5) Fisher, H. O., "Air Traffic Control Problems in the New York Area," Address before Seventh Annual Meeting and Forum, National Business and Aircraft Association, Dallas, October 29, 1954.

6) Frederick, J. H., **Commercial Air Transportation,** Homewood, Illinois: Richard D. Irwin, Inc., 1961.

7) Oceanographic Office, **Notice to Mariners,** Annapolis, Maryland: U. S. Navy (latest issues).

8) Petroleum Panorama; Commemorating 100 years of Petroleum Progress," **Oil and Gas Journal,** January 28, 1959 (entire issue).

9) U. S. Coast Guard, **List of Lights and Other Marine Aids,** Washington, D. C.: (current issue).

10) U. S. Federal Aviation Agency, **National Airport Plan,** Washington, D. C.: Government Printing Office, 1962.

INSTRUCTOR'S UNIT PLAN

Unit 16
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Maintenance of Transportation Systems**

AIM: To develop skill in recognizing the need for and applying preventative maintenance on transportation systems.

INSTRUCTIONAL AIDS:

Transparencies - Set of 21 transparencies on **Power Technology**; includes all types of engines and power sources, Philadelphia: DCA Educational Products, Inc.

Miscellaneous - Posters, charts, paint chips, samples of woods and metals and other maintenance equipment.

EQUIPMENT:

Overhead projector, screen and models of transport facilities.

PRIMARY REFERENCES:

1) Duffy, J. W., **Power - - Prime Mover of Technology**, Bloomington, Ill.: McKnight & McKnight Publishing Company, 1964.

2) **Mechanical Manual 1959-1967**, Volume 2, Berkeley, California: National Automotive Service Company, 1967.

3) Toboldt, William K. and Johnson, Larry, **Motor Service's Automotive Encyclopedia**, Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1969.

4) **Why Preventative Maintenance?**, Pontiac, Michigan: GMC Truck and Coach Division of General Motors Corporation (booklet).

I. INTRODUCTION and MOTIVATION

A. Show photographs of a terminal and one or more vehicles that have not had regular maintenance and start a discussion on the effects of "run-down" facilities on use and hence growth of the carrier.

II PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Carrier maintenance.	1. Body. a. Refinishing and repair b. Replacement 2. Chassis or frame. a. Suspension 3. Engine preventative maintenance. a. Diesel b. Gasoline c. Jet d. Steam turbine 4. Accessories. 5. Tune-up and adjustments on carrier.	1. Selection of materials to withstand weather, wear, and abuse. 2. Principles of operation of the basic vehicular power plants. 3. Diagnostic procedures.
B. Way maintenance.	1. Highway. a. Patching, paving, repairs b. Signs, litter, damage, etc. c. Grades 2. Railway. a. Tracks and ties b. Grades 3. Waterway. a. Canals, rivers, channels b. Locks and dams c. Side walls and debris 4. Airway. a. Obstructions b. Approaches 5. Pipeline trench. a. Leaks, breaks, deterioration b. Setting and ground clearance 6. Elevators, escalators, conveyors. a. Cable and track repair b. Lubrication	1. Asphalt composition. 2. Characteristics of asphalt, concrete, and other road building materials. 3. Ecological deterioration in waterways. 4. Reaction of acids and other soil chemicals on pipelines. 5. Preventatives for undergound protection.
C. Terminal or facility maintenance.	1. Building construction and repair. 2. Painting . . . interior and exterior 3. Interior cleaning, waxing, and polishing. 4. Masonry cleaning and repair. 5. Plumbing, heating, and air conditioning. 6. Electrical maintenance.	1. Composition of paints and finishes. 2. Waxes and polishes. 3. Chemicals used for cleaning. a. Wood b. Metal c. Masonry d. Glass

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Estimating cost of repairs and maintenance. 2. Costs of engine purchase and operation. a. Combustion efficiency b. Replacement period (planned obsolescence)	1. Identifying characteristics of carriers.	1. Maintaining a nuclear power plant. 2. Fiber glass materials used for carrier bodies and their effects on maintenance. 3. History and development of internal combustion engines.
1. Highway use tax.	1. Understanding codes and specifications. 2. Unnecessary maintenance due to ignoring recommendations, or discarding operational instructions.	1. Socioeconomic effect of communities on roadway maintenance. 2. Problems of water pollution and waterway maintenance. 3. Additional costs to taxpayers for litter collectors on highways, along railways, and waterways.
1. Figuring expansion costs.	1. Reading building plans, blueprints, and architectural plans.	1. Union control of building maintenance workers.

III. APPLICATION

A. Students should gain experiences with basic maintenance activities such as lubrication, painting and varnishing, cleaning and polishing and general repair.

IV. EVALUATION CRITERIA GUIDELINE

A. What are the basic skills needed for building maintenance?

B. Which of the carrier ways seem to require more periodic maintenance than others? Why?

C. What type of training is normally expected for employees in carrier maintenance?

V. SUMMARY

A. Periodic maintenance and service is requisite to successful operation of facilities, The importance of constant service cannot be overemphasized. Improper maintenance creates safety hazards, delays and undependable transportaton which is directly opposed to the National Transportation Policy Goals.

VI. SUGGESTED TIME and SEQUENCE LISTING

180 minutes . . . Experience with maintenance and service activities.

180 minutes . . . Related concepts in science, math, communications and social studies.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Crouse, William H., **Automotive Transmissions and Power Trains,** New York: McGraw-Hill Book Company, 1967, Third Edition.

2) **Electricity and Wheels,** Detroit: General Motors Corporation.

3) Elting, Mary, **Trucks At Work,** Irvington-on-Hudson, New York: Harvey House, Inc., 1962.

4) **Motor's Auto Repair Manual,** New York: Motor Publishing Company, 1969, 32nd Edition.

5) **Motor's Auto Wiring Diagrams,** New York: Motor Publishing Co., 1969.

6) **Motor's Quick Service Manual,** New York: Motor Publishing Co., 1969.

7) Rogers, Don E., **Engines: Progress and Power,** Racine, Wisconsin: Whitman Publishing Company, 1962.

INSTRUCTOR'S UNIT PLAN

Unit 17
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Safety**

AIM: To develop a knowledge of the importance of safety and dependability in transport operations and to develop an understanding of safety features designed into carriers and ways and their safe operation.

INSTRUCTIONAL AIDS:

Slides - **Safety,** Sponsored by Pure Oil Company, Washington, D. C.: American Trucking Association.

Film - **Merchant Marine Safety.** New York: United States Coast Guard, Third District, 1962 (16 mm, sound, color, 28 minutes).

Film - **Never Argue with a Train.** Chicago: Illinois Central Railroad, 1961 (16 mm, sound, 10½ minutes).

Film - **Tomorrow's Drivers.** Detroit: Chevrolet Motor Division of General Motors Corporation (16 mm, sound, B&W, 10 minutes).

Photographs of accidents with detailed reports on how they occurred.

EQUIPMENT:

16 mm projector, 35 mm projector and screen.

PRIMARY REFERENCES:

1) ATA, **The Motor Carrier and Safety Regulations,** Washington, D. C.: The Association.

2) Chapman, C. F., "Piloting, Seamanship and Small Boat Handling," New York: **Motor Boating,** 1970 edition.

3) National Safety Council materials.

4) Van Houten, J. C. and Clevenger, C. E., **Essentials of Modern Transportation for Colleges.** Dubuque, Iowa: Wm. C. Brown Company, 1957.

I. INTRODUCTION and MOTIVATION

A. Introduce students to the importance of safety by showing one of the above films. Point out the seriousness of accidents and loss of human life as well as damage and probable loss of vehicles involved.

B. Discuss the personal ingredients of safety operations and accident prevention.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Importance of safety and dependability.	1. On-schedule movement and delivery of goods and passengers. a. Delays b. Coordination of services	
B. Safety characteristics of modes.	1. Safety features designed into carriers and ways. a. Replacement or repair of carriers b. Control of weather hazards on road, rails, etc. c. Traction and horsepower d. Stability in vehicle design and operation e. Speed control devices f. Traffic controls g. Impact control h. Fire control i. Heating and ventilation j. Metallurgy of cables and materials used such as in conveyors, elevators, and aerial tramways 2. Safety factors in operation of vehicles. a. Human factors b. Precautionary measures taken under various weather conditions c. Acceleration, braking, and control d. Observation of safe driving rules e. Physical requirements f. Defensive driving	1. Basic weather conditions and their effects on transport. 2. Principles of traction. 3. Concept of horsepower. 4. Combustible materials and extinguishing chemicals. 5. Requirements in ventilation and oxygen supply. 6. Metallurgy in carrier construction materials. 7. Metallurgy in power plant construction. 8. Principles of expansion, contraction, and stretching of materials. 9. Effect of alcohol and drugs on human system.
C. Specific safety practices of the various modes.	1. Railroads. 2. Motor carriers. 3. Marine vehicles. 4. Aircraft. 5. Pipelines. 6. Conveyors and escalators. 7. Elevators. 8. Aerial tramways.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
	1. Scheduling and dispatching problems of off-schedule trips.	
1. Measuring, traction and friction. 2. Determining horsepower. 3. Figuring Cfm's. 4. Allowances for material variations due to weather conditions. 5. Estimating speed and stopping distances.	1. Reporting weather conditions 2. Communications through traffic control systems. 3. Reading labels, instructions, and essential documents.	1. Effects of blizzards and extreme weather conditions on communities, particularly transportation. 2. Influence of horsepower and speed on buyers. 3. Safety controls in vehicle manufacturing. 4. Human engineering. 5. History of societal control of transportation development. a. Automobile b. Airplane
1. Statistical gathering and analysis systems.		1. Safety records by modes.

III. APPLICATION

A. Students should be asked to submit a report (orally or written) on some accident they have observed or been involved in relating to transportation. They can describe how it happened, how it could have been prevented and what precautions need to be taken to prevent this situation from recurring.

IV. EVALUATION CRITERIA GUIDELINE

A. What is the effect of human error on accident prevention?

B. How would you rank the various modes in order of their safety records? (From fewest to most).

C. How can carriers or vehicles be redesigned for better safety?

V. SUMMARY

A. The general public is becoming much more safety conscious particularly from the investigations and remarks of Ralph Nader. Public pressure will be placed on highway transport to reduce the number and seriousness of accidents in the near future. Why does society wait until sufficient pressure or opinion is generated on a problem before it acts?

VI. SUGGESTED TIME and SEQUENCE LISTING

60 minutes . . . Show films on safety.

100 minutes . . . Student reporting and review of accident prevention programs and materials.

180 minutes . . . Related concepts.

20 minutes . . . Review and evaluation.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) **Design for Safety,** Detroit: General Motors Corporation (booklet).

2) **Guide to Traffic Safety Literature.** Chicago: National Safety Council, current edition.

3) **Right Behind the Wheel.** Detroit: General Motors Corporation (booklet).

4) **Traffic Control and Roadway Elements: Their Relationship to Highway Safety.** Washington, D. C.: Automotive Safety Foundation, 1963.

INSTRUCTOR'S UNIT PLAN

Unit 18
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Metropolitan Transportation**

AIM: To develop an understanding of the problems facing metropolitan transport and some proposals for their solution.

INSTRUCTIONAL AIDS:

Film - **The Unending Renaissance,** New York: Association Films, Inc. (16 mm, sound, color, 28 minutes).

Film - **Urbanization,** Jeffersonville, Ind.: United States Bureau of the Census (16 mm, sound, 30 minutes).

EQUIPMENT:

16 mm projector, screen and diarama of a city or model city layout with model transportation vehicles.

PRIMARY REFERENCES:

1) American Municipal Association, **The Collapse of Commuter Service, A Threat to the Survival of America's Metropolitan Areas,** Washington, D. C.: The Association 1960.

2) "The Exploding Metropolis," New York: **Fortune Magazine,** Doubleday & Company, Inc., 1958.

3) **Reference Guide to Metropolitan Transportation, A,** Evanston, Illinois: Northwestern University Transportation Center, 1964.

4) Ritter, P., **Planning for Man and Motor,** New York: Macmillan Company, 1964.

I. INTRODUCTION and MOTIVATION

A. Either visit a city or show one of the films listed above to give students a general acquaintance with the problems of metropolitan transportation. If possible, invite a speaker to give an illustrated talk on what "his" city is doing about this problem and why.

II. PRESENTATION of INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Urban transport . . . a critical problem.	1. Concentration of population. 2. Effects of increased automobile use in cities. 3. Population shifts. a. Suburbs b. Rural areas 4. Decline of mass transit in cities. 5. Urban transport facilities. a. Trolley and cable car b. Bus lines c. Subway d. Taxi cab e. Elevated and electric rail f. Terminals 6. Traffc patterns and control. 7. Vandalism.	1. Effects of population explosion on transportation. 2. Recent efforts to solve mass transit problems: a. Hovercraft b. High speed rail transit c. Short take-off and landing airplanes 3. Explore other means of transporting people and goods. 4. Recent attempts to curb vandalism and theft by altering vehicle design and operation. 5. Recycling of junk cars.
B. The automobile problem.	1. Rush-hour traffic. 2. Highway and street capacity. 3. Parking. 4. Abandoned cars	
C. Public vs. private transportation.	1. Advantages and disadvantages of each. 2. Declining use of public transport. 3. Lack of innovation in public transport to attract commuters. 4. Increased cost of operation and maintenance of public transport. 5. Noise and pollution problems.	
D. Facing the problem.	1. Urban transport and national security. 2. Urban master planning and renewal. 3. Federal assistance. 4. Traffic studies. 5. Trends in metropolitan growth. 6. Changing role of terminals. 7. Technological innovations. 8. Managerial and financial changes. 9. Role of state in providing free public transportation or at nominal cost.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Determining fares from cost formulas. 2. Demonstrate the effect fare restrictions have on ability to meet operational expenses.	1. Surveys of transport needs and desires of urban residents. a. By ethnic groups b. By social-economic groups c. By occupational groups	1. Transportation and land values in the city. 2. Effects of urban planning and renewal on transportation. 3. Urban transport and minority groups. 4. Vandalism in transport vehicles and facilities . . . how to cope with it.
1. Traffic simulation programs.		1. Human tolerance in peak-hour traffic. 2. Increasing problem of abandoned cars on city streets.
	1. Debate issues of public vs. private transport in cities.	1. Personal security as a factor in deciding upon private vehicle. 2. Maintaining cleanliness in vehicles and terminal facilities.
		1. National interest in urban transport. 2. Arguments for and against state and nationally owned transportation systems.

III. APPLICATION

A. Students should either have an opportunity to spend a day with urban offices engaged in planning, operating and maintaining transportation and see the facilities, problems and improvements as they exist, or devote attention to planning a metropolitan center and its total transportation services and facilities.

IV. EVALUATION CRITERIA GUIDELINE

A. What are the most pressing problems in urban transport?

B. Who is responsible for these problems?

C. What are some trends in urban transport?

D. What control and support should the state and national governments have over urban transportation systems?

V. SUMMARY

A. Metropolitan transportation is one of the nation's leading critical problems. We are just now beginning to realize the seriousness of this problem and are developing proposals to solve some of the major issues.

VI. SUGGESTED TIME and SEQUENCE LISTING

60 minutes . . . Speaker from a metropolitan planning commission.

180 minutes . . . Work with model city layout to plan transportation systems; or spend the day with urban planners to observe the transport systems and facilities.

120 minutes . . . Related topics.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Burck, G., "How to Unchoke Our Cities," **Fortune**, Volume LXIII, No. 5 May 1961.

2) Meyer, J. R., Kain, J. F. and Wohl, M., **The Urban Transportation Problem**, Cambridge, Mass.: Harvard University Press, 1965.

3) Owen, W., **The Metropolitan Transportation Problem**, Washington, D. C.: The Brooklings Institution, 1956.

4) The Port of New York Authority, **Metropolitan Transportation - - 1980**, New York: The Port Authority, 1963.

5) U. S. Congress, House of Representatives, **Urban Mass Transportation Act of 1963**, Washington, D. C.: 88th Congress, 1st Session, Report No. 204, April 9, 1963.

6) Yoshpe, H. B. and Brown, F. R., **Transportation: The Nation's Lifelines**, Washington, D. C.: Industrial College of the Armed Forces, 1961.

INSTRUCTOR'S UNIT PLAN

Unit 19
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Future Transportation Systems and Vehicles**

AIM: To acquaint students with the experimental systems being developed and tested for the future.

INSTRUCTIONAL AIDS:

Filmstrip - **Transportation: Where Do We Go From Here?** (M-420300), Pleasantville, New York: Guidance Associates, Harcourt, Brace and World, Inc., 1968 (118 frames, color, 19 minutes with record).

Film - **Transportation.** Los Angeles: Film Associates (super 8 mm, color).

Film - **The Supersonic Jet Race.** (BS-900), Ridgefield, New Jersey: Association Films (16 mm, sound, 26 minutes).

Film - **Traffic Round the World.** (BS-770), Ridgefield, New Jersey: Association Films (16 mm, sound, 26 minutes).

Photographs - Of experimental vehicles and systems.

EQUIPMENT:

Super 8 mm, 16 mm projectors, screen simulation models of some of the experimental equipment and systems being designed.

PRIMARY REFERENCES:

1) George, P. C., "Mass Transit: Problem and Promise," Minneapolis, Minn.: Walker Art Center, 1968 (**Design Quarterly 71**).

2) Hellman, H., **Transportation in the World of the Future.** New York: M. Evans and Company, 1968.

3) "Transportation: Breaking Through the Distribution Barrier," Special Report, **Dun's Review and Modern Industry,** June 1963.

4) "Transportation for the Seventies and Beyond," **Engineering Opportunities,** Winter, November 1967, pp. 34-50.

I. INTRODUCTION and MOTIVATION

A. Start Class by showing film: **Transportation: Where Do We Go From Here?** Develop an awareness to the problems of a rapidly growing transport system in the U. S.

II. PRESENTATION OF INTEGRATED CONCEPTS

		RELATED CONCEPTS
INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Transportation today.	1. Urban transport. 2. Intercity transport. 3. Mass transit systems. 4. Interstate transport. 5. General.	
B. Transportation systems projected for the future.	1. Rail systems. a. High-speed rail b. Auto-train c. Railway (car feery) d. San Francisco's BART e. Washington's METRO f. Innovations in Boston's and New York's subway systems g. Cleveland's SCOT 2. Horizontal elevators. 3. Monorails. 4. Pneumatic tube systems. a. Edward's system 5. Ground affects machines or air cushion vehicles. a. Hovercraft (British) b. Hovercar c. Aerotrain (French) d. Hovair (General Motors) e. Uniflo 6. Bells "Pogo" jet belt. 7. Air systems. a. Helibus b. VTOL and VSTOL c. Supersonic craft 8. Small car systems. a. Automated highway b. Teletrans (Detroit) c. StaRRcar d. Electric urbmobilies e. Metrain (MIT)	1. Effects of environmental factors on vehicles: (water, air, ground). 2. Demonstrate and explore the scientific principles which make experimental vehicles function. a. Hovercraft b. Hydrofoil c. Pneumatic tube
C. Areas of technological development.	1. Vehicle design. 2. Suspension and control. 3. Power systems. 4. Conveyor systems. 5. Ways. 6. Terminal design and operations. 7. Maintenance and service.	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Research and statistical gathering systems.	1. Read magazines and booklets explaining and illustrating new ideas in transportation.	1. Societal problems with the present transportation systems. 2. Rallying a splintered and operationally independent transportation system to an intermodal-coordinated system.
1. Financing experiments.	1. Assesing transport needs and desires through personal survey and interviews.	1. General effects of innovations in transportation on: a. Social activity b. Home and family c. Politics d. Economics e. Religon 2. Where will new transportation costs come from? 3. Issue of government-owned transport systems vs. privately-owned systems.
		1. New programs to train repair and maintenance personnel for future transport systems. 2. Designing education curricula for cluster programs in vocational training.

III. APPLICATION

A. Most of the application will be in the area of studying these systems and how they work. If possible, students can make simulation models of some of the experimental vehicles and systems. Some models are available from toy manufacturers.

IV. EVALUATION CRITERIA GUIDELINE

A. What technological changes in vehicles seem to be most prevalent in the experimental vehicle?

V. SUMMARY

A. One of the greatest revolutions in transportation since the wheel is the air cushion suspension system. This development is predicted to revolutionize transportation in the next two decades. Air can replace wheels, tracks and hulls.

VI. SUGGESTED TIME and SEQUENCE LISTING

40 minutes . . . Film and discussion on obvious trends in transportation.

180 minutes . . . Study and model work with transportation systems.

140 minutes . . . Related concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) Calder, N., **The World in Nineteen Eighty-Four,** Volumes 1 & 2, Baltimore: Penguin Books, 1965.

2) Firestone, H. S., **Man on the Move.** New York: G. P. Putnam's Sons, 1967.

3) "Hovercraft Skim to a Bright Future," Trenton, New Jersey: **Evening Times,** Wednesday, May 6, 1970.

4) Massachusetts Institute of Technology, **Project Metra'n: Boston 1990,** MIT Press, 1967.

5) Pell, C., **Megapolis Unbounds: The Supercity and Transportation of Tomorrow,** New York: F. A. Praeger, Inc., 1966.

6) Ruppenthal, K. E. and McKinnell, H. A., **Transportation and Tomorrow,** California: Stanford University Graduate School of Business, 1962.

INSTRUCTOR'S UNIT PLAN

Unit 20
Lesson 1
Time . . . . . 6 hours

CLUSTER: TRANSPORTATION

DIVISION: TRANSPORTATION SYSTEMS

SUBJECT: **Careers in Transportation**

AIM: To provide information and general requirements for entrance into a career in the transportation field.

INSTRUCTIONAL AIDS:

Film - **Aviation Mechanic** (FA-315), Washington, D. C.: Federal Aviation Administration, 1964 (16 mm. sound, color, 17 minutes).

Film - **Auto Mechanic and Technician.** Dearborn, Michigan: Ford Motor Company, 1968 (16 mm, sound, color, 23 minutes).

Film - **Jonah and the Highway.** New York: United States Steel Corporation, 1958 (16 mm, sound, 25 minutes).

Film - **Long Ships Passing.** Cleveland, Ohio: Lake Carrier's Association, 1967 (16 mm, sound, color, 32 minutes).

EQUIPMENT:

16 mm projector and screen.

PRIMARY REFERENCES:

1) Hopke, W. E., "Planning Your Carrier," Volume I of the Encyclopedia of Careers and Vocational Guidance, New York: Doubleday and Company, Inc., 1967.

2) Selected brochures from the various trades and occupations in transportation.

3) U. S. Department of Labor, **Occupational Outlook Handbook.** Washington, D. C.: U. S. Government Printing Office, 1968-69 Edition.

4) Vocational Guidance booklets from General Motors Corporation, Detroit Michigan:

a. **Can I Get the Job?**
b. **GM Educational Opportunities.**
c. **Your Future with Fisher Body.**

I. INTRODUCTION and MOTIVATION

A. Have students begin to list the jobs and occupations they are familiar with in transportation. Show film on **Aviation Mechanics** and compare the jobs seen in the film with those they have listed.

II. PRESENTATION of INTEGRATED CONCEPTS

RELATED CONCEPTS

INSTRUCTIONAL TOPICS	TECHNICAL CONCEPTS	SCIENCE
A. Transportation industry facts.	1. Review Unit 1 . . . Overview of Transportation Systems. 2. Additional facts. a. Number employed b. Passenger and freight mileage c. Economic advantages d. Impact on standard of living e. Increase in movement of goods and growth of industry f. Lifeblood of nation g. Largest share of GNP	
B. Basic occupational groups in transportation industries.	1. Professional. a. Engineers b. Designers c. Draftsmen d. Research e. Planners and programers 2. Managerial. a. Industrial traffic b. Purchasing c. Corporation 3. Clerical and sales. a. Stenographers and secretarial b. Machine operators c. Shipping and receiving d. Carrier sales and parts 4. Skilled trades. a. Construction and manufacture of facilities and vehicles b. Drivers, pilots, and captains c. Mechanics d. Maintenance e. Specialist f. Technicans 5. Services. a. Ticket reservations, sales b. Personal services c. Scheduling and dispatching d. Communication e. Traffic controllers f. Stewardesses and hostesses 6. Government agencies. a. FAA, CAA b. Corps of Engineers c. Coast Guard d. National offices for each of the modes	

TO BE DEVELOPED

MATH	COMMUNICATIONS	SOCIAL STUDIES
1. Economic benefits of modern transportation. a. Time and place utility	1. Reading graphs, charts, tables, and figures.	1. Impact of transportation on society.
1. Salary ranges for each occupation. a. Hourly pay b. Salary c. Commission 2. Cost of education or training for jobs.	1. Employee test and examinations. 2. Reading and interpreting test scores. 3. Employee-employer relations. 4. Importance of communicating a willingness to serve passengers. 5. Radio and telephone communications. 6. Teletype systems.	1. Discuss Vance Packard's STATUS SEEKERS. 2. Job image and prestige: Why do most people prefer "White collar" jobs?

III. APPLICATION

A. Students can become involved in the responsibilities of a few of these occupations through reading, discussing, observing and role playing activities. Students should have a fair knowledge of careers in transport as a result of their study of the Transportation Systems Volume. A visit to one or more of the transportation industries purposefully to talk with personnel managers and workers in the industry should provide first-hand information.

IV. EVALUATION CRITERIA GUIDELINE

A. What general qualifications are necessary for the "glamorous" jobs in transport (airplane pilot, executive, etc.)?

B. Identify which jobs require a college education, a high school education, neither of these.

V. SUMMARY

A. A career in transportation is a wise investment since this whole field is growing so rapidly and developing new services and opportunities for interested persons. The fastest growing and perhaps most glomorous is the air transport and aviation industries. There appears to be truly unlimited opportunities in this area.

VI. SUGGESTED TIME and SEQUENCE LISTING

180 minutes . . . Role playing experiences and study, or visit to a transport facility to observe career opportunities.

180 minutes . . . Related concepts.

VII. SUPPLEMENTAL REFERENCES and RESOURCE MATERIAL

1) **Dictionary of Occupational Titles.** Volume I, Definitions of Titles, and Volume II, Occupational Classification, Washington, D. C.: U. S. Government Printing Office, 1965.

2) Liston, R., **Your Career in Transportation.** New York: Julian Messner, Inc., 1966.

3) Moser, D. E. and Kriebel, W. R., **Transportation in Agriculture and Business.** Manual 63, Columbia, Missouri: University of Missouri Extension Division, 1964.

4) **Silent Carriers.** Pelham, New York: Humble Oil Company (booklet).

5) Taff, C. A., **Management of Traffic and Physical Distribution.** Homewood, Illinois: Richard D. Irwin, Inc., 1964.

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Automobile Manufacturers Association, Inc., **1967 Automobile Facts and Figures,** 320 New Center Building, Detroit, Michigan 48202.

Automotive Safety Foundation, **What Freeways Mean to Your City,** 200 Ring Building, Washington, D. C. 20036, January 1964.

Basic Safety Program for Barge and Towing Vessel Industry, Suite 502, 1250 Connecticut Avenue, Washington, D. C. 20036: The American Waterways Operators, Inc.

Big Load Afloat, Suite 502, 1250 Connecticut Avenue, Washington, D. C. 20036: The American Waterways Operators, Inc.

Blaisdell, Ruth F., et al., **Sources of Information in Transportation,** Evanston, Ill.: Northwestern University Press, 1964.

Brown, Harrison, et al., **The Next Hundred Years,** New York: Viking Press, Inc., 1936.

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Cathcart, Kathryn, **The Foreseeable Future,** New York: Glencoe Press, 1968.

Clarke, Arthur C., **Profiles of the Future,** New York: Harper & Row Publishers, Inc., 1963.

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Connecticut General Life Insurance Company, **Aviation and the Transportation System: Progress, Profits and the Public Interest. Panel II, Aviation and Technological Progress: The Search for Better Ways,** Bloomfield, Conn.: February 1967.

Cornell Aeronautical Laboratory, Inc., **Metrotrain --2000 -- A Study of Future Concepts in Metropolitan Transportation for the Year 2000,** Buffalo, New York 14221: Cornell University, October 1967.

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Foa, J. V., **An Introduction to Project Tubeflight,** Rensselaer Polytechnic Institute, September 1966.

Gablehouse, Charles, **Helicopters and Autogiros,** Philadelphia: J. B. Lippincott Company, 1967.

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Giles, Joseph, **Bridges and Men,** New York: Grosset & Dunlap, Inc., 1963.

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Halacy, D. S., Jr., **Bionics: The Science of Living Machines,** New York: Holiday House, Inc., 1965.

Hall, E. N., **Central Elements of a National Transportation System,** East Hartford, Connecticut 06108: United Aircraft Corporation Report, October 1967.

Hammond, R., **Tunnel Engineering,** New York: The Macmillan Company, 1959.

Hill, D. Y., **Bridge Calculation and Design,** London: Griffin, 1962, 2nd Edition.

Hill, F. E., **The Automobile: How It Came, Grew and Changed Our Lives,** New York: Dodd, Mead & Company, 1967.

Hoffman, G. A., **Omminizing the Land Used by Automobiles and Buses in the Urban Central Core: Underground Highways and Parking Facilities,** Santa Monica, Calif. 90406: Rand Corporation Report #P-3002, October 1964.

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Inland Waterways Operators Pollution Manual, Suite 502, 1250 Connecticut Avenue, Washington, D. C. 20036: The American Waterways Operators Inc.

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McLean, W. B., "Future Exploration of the Ocean," July 1966.

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